

November

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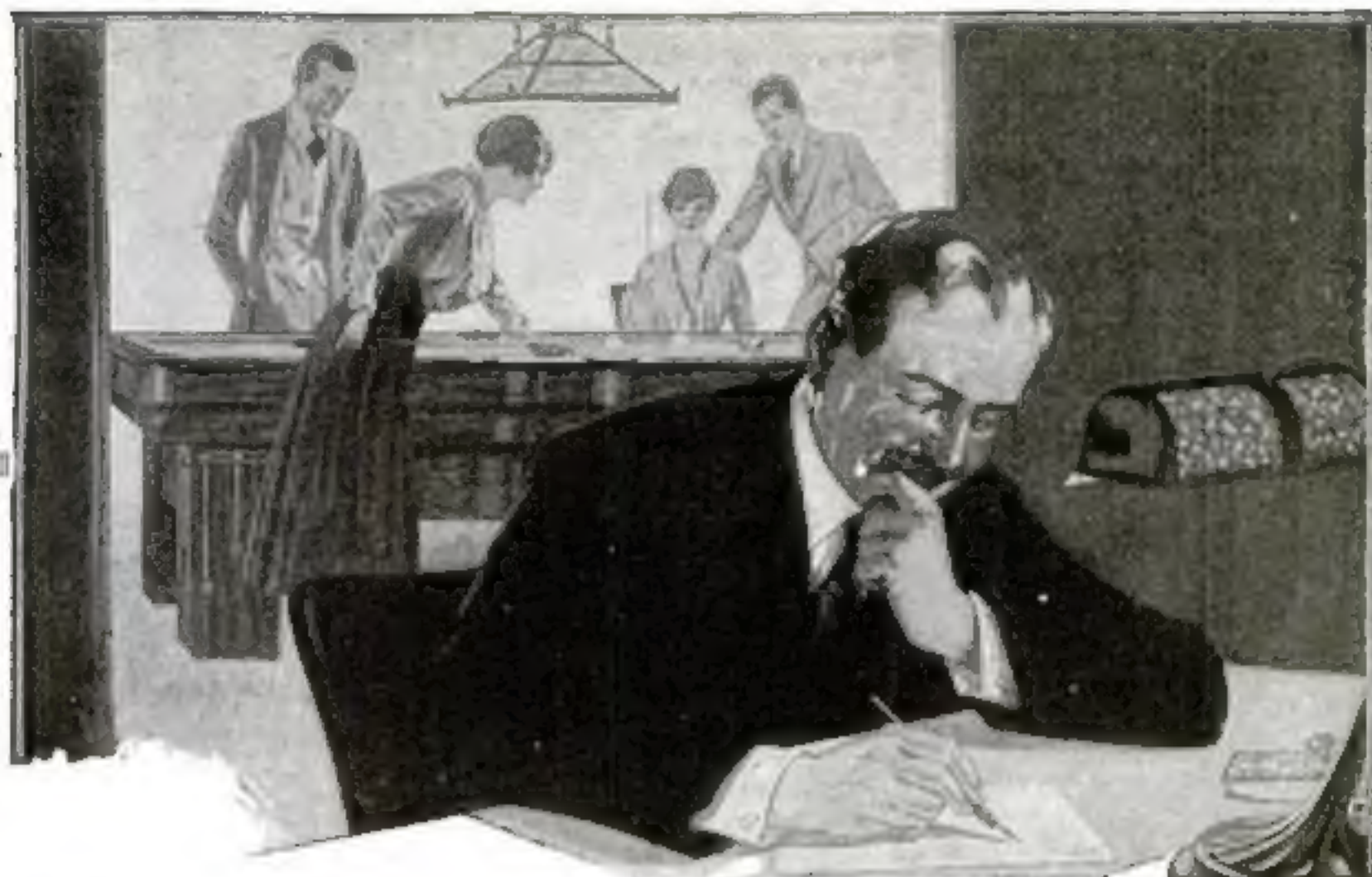
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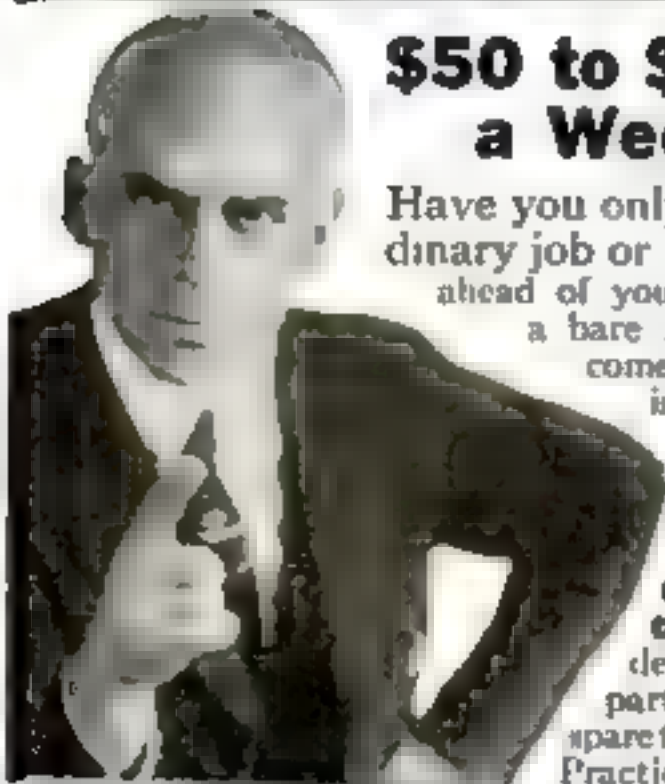
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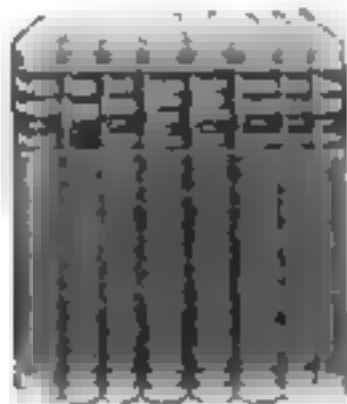
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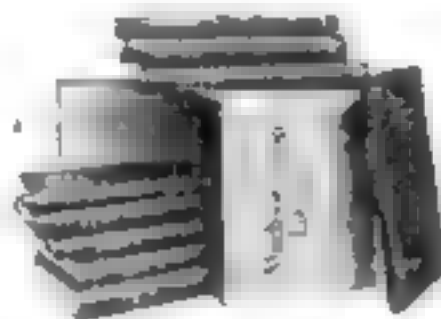
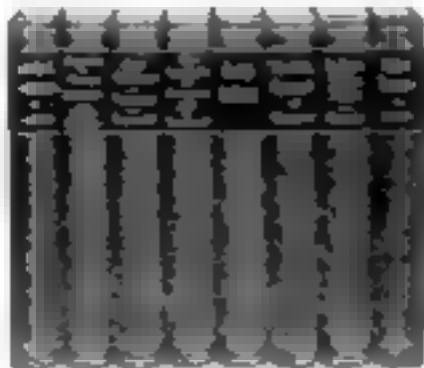
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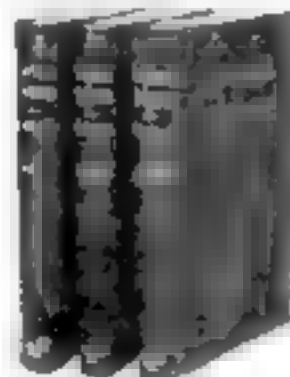
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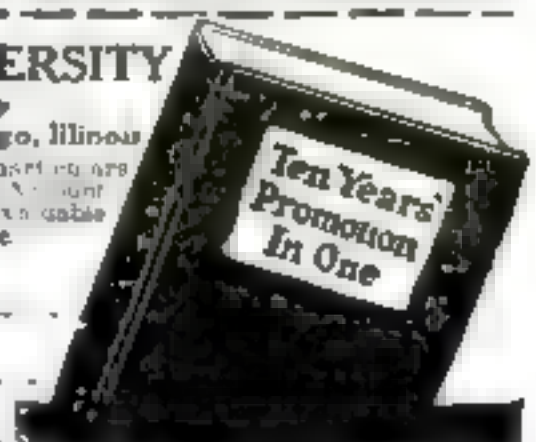
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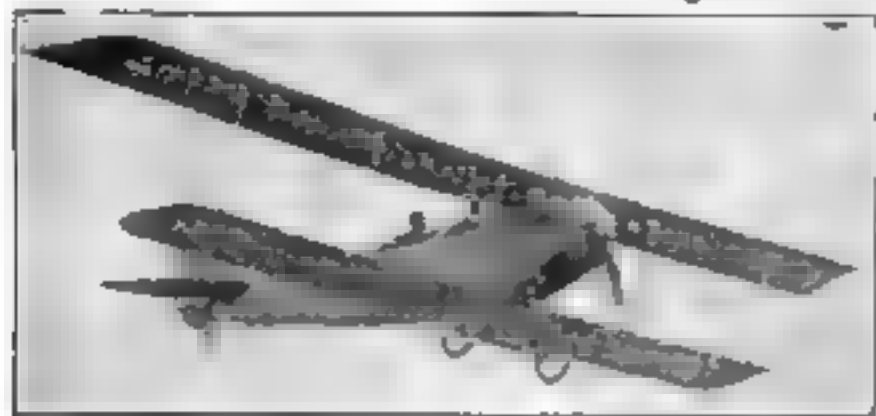
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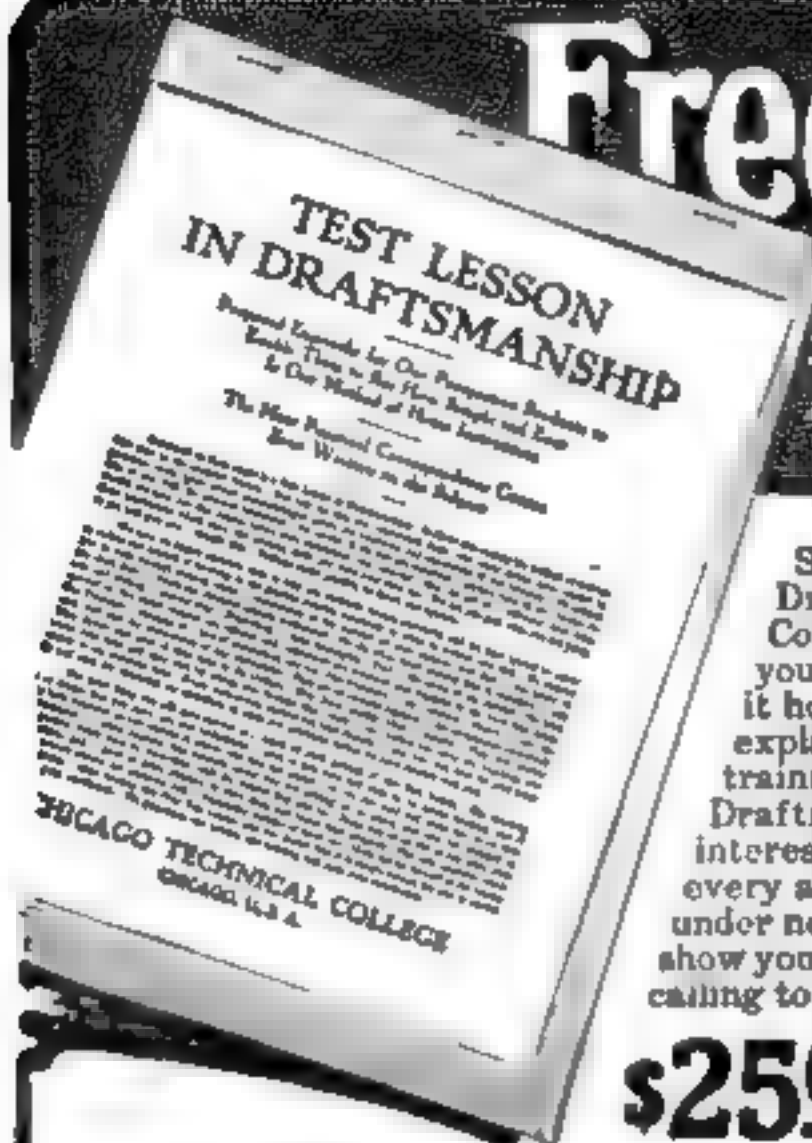
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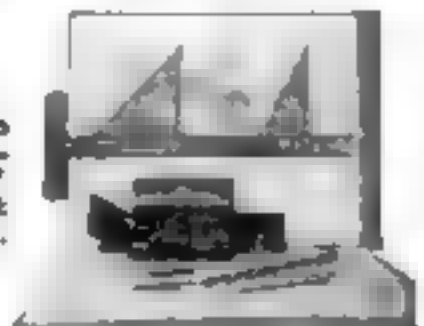
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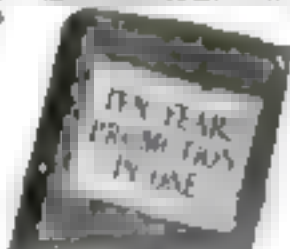
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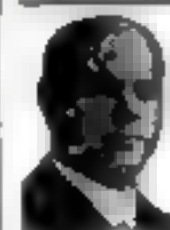


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The Oliver Typewriter Company
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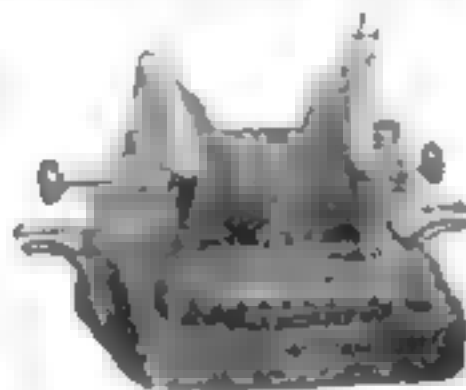
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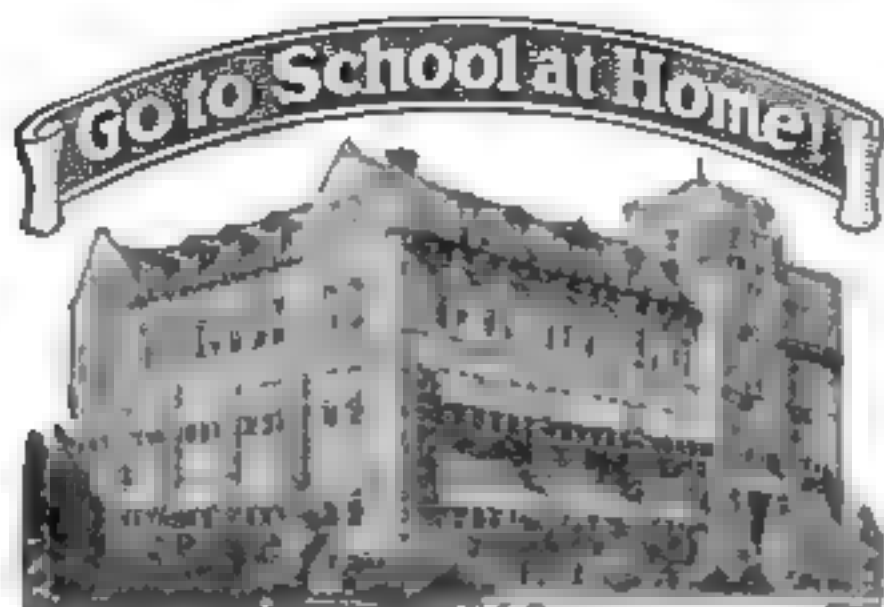
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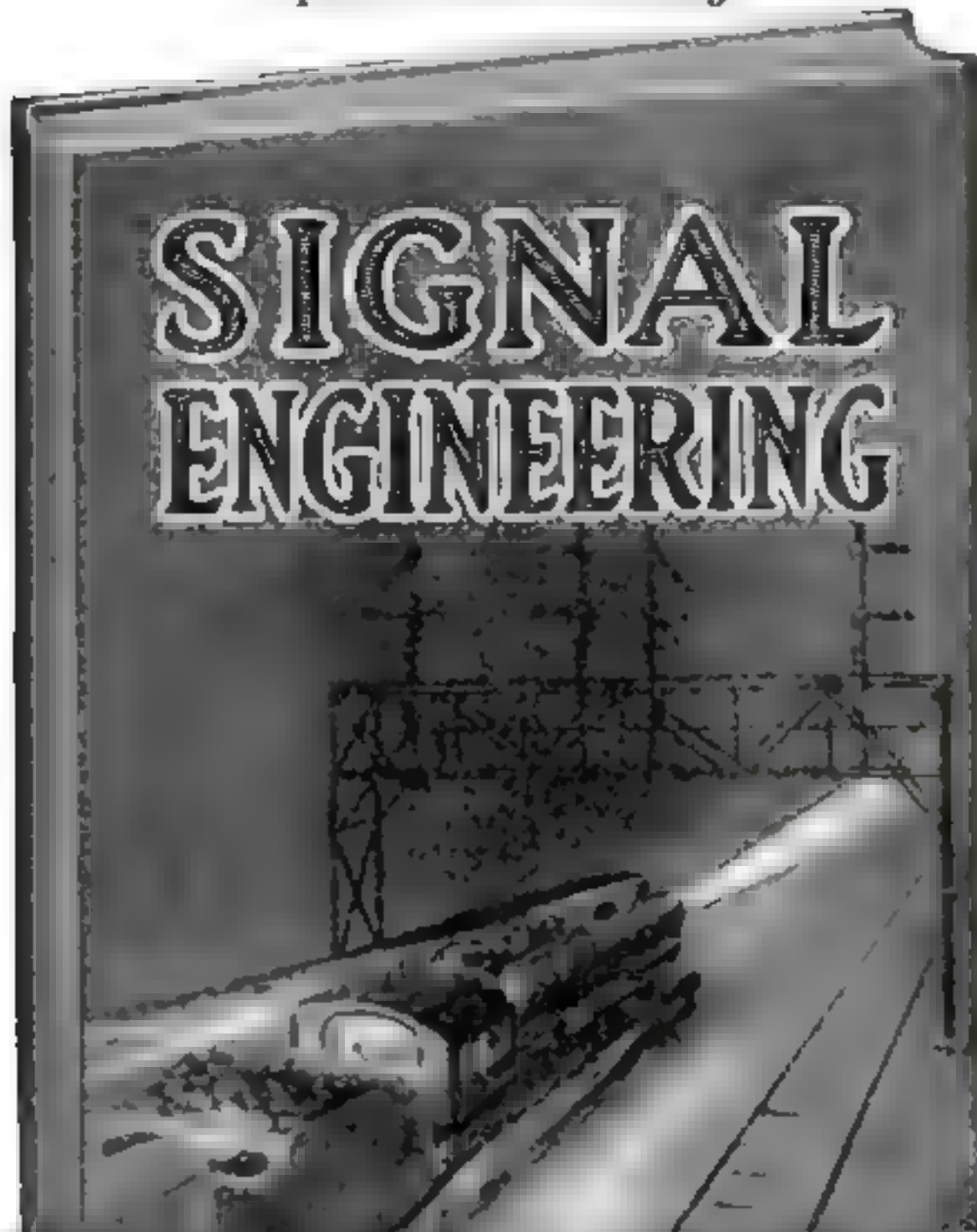
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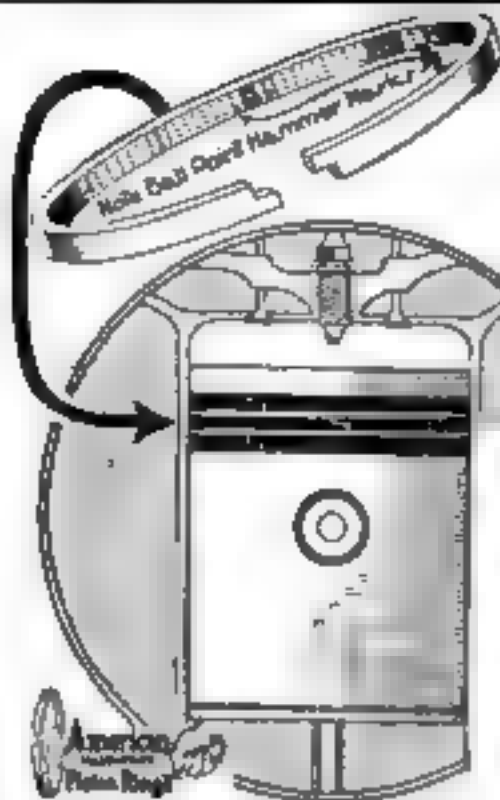
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Every dollar wasted in freight charges represents a dollar of wasted profit or a dollar of wasted opportunity. In business today, freight charges are a vital factor in governing prices. By accepting every existent advantage in rates, a concern, or a city, can vastly undersell its competitors who waste traffic dollars.

A Few Reasons Why

A concern in South Chicago had been shipping about 200 cars of Coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about \$5.00 on each car. Thus, on this one item alone a saving of over \$300,000 a year was effected.

In St. Louis, through misrouting of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over \$27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were exorbitant. A ruling issued from the Interstate Commerce Commission resulted in a refund of \$122,000.

An oil shipper in Kansas was losing over \$30 every day—\$700 monthly—because he did not know of certain tariff regulations entitling him to lower rates.

These are but a few instances of what is occurring every day in the traffic industry. Tens of thousands of concerns, without realizing it, are losing fortunes every year because they do not know that there are countless classifications, special freight services and rate combinations which legally entitle them to rates that would amaze them if they but knew.

Is it any wonder that competent traffic experts are paid \$2,500 to \$10,000 and even up to \$25,000 and \$10,000 a year? Is it any wonder that firms are glad to pay a percentage of what traffic managers save? The man who can do it is in high command and instead of finding himself in the position of even asking for a raise, generally has several firms bidding for his services. Why not? It's no hardship to pay a big salary out of losses turned into profit.

Your Life-Time Opportunity

There are about 50,000 large business corporations and about 400,000 smaller shippers which must be protected by competent traffic men. These concerns

have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to save the money now being wasted through lack of efficiency in applying the Government Freight Rate System. It is estimated that over 100,000 more traffic experts are needed at once.

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Through its Advisory Council, every member of the American Commerce Association receives the help of such men as T. Albert Gantt, traffic manager, Corn Products Co.; Wm. Scott Cowie, freight agent Erie R. R.; Samuel G. Lutz, general traffic manager Chicago & Alton R. R.; Chas E. Mayer, traffic manager Stone & Webster Engineering Corporation; T. J. Harkrader, traffic manager American Tobacco Co.; as well as nearly 200 others of equal prominence.

Startling Book Free

The Course in Traffic Management is adapted to beginners as well as to those already engaged in traffic work. The instruction has been endorsed by such men as Robt H. Forbes, traffic manager Butler Bros. New York, J. F. Brown, manager transportation department Chicago Board of Trade, H. G. Wilson, traffic manager of the Toledo Board of Trade; Ira S. Bassett, traffic commissioner Pittsburg Commercial Club, W. H. DeWitt, Eastern traffic manager Western Electric Co., and hundreds of others equally prominent.

It is impossible to go into details in this limited space, but the Association has published a remarkable book for free distribution which explains the instruction in detail and tells how anyone may quickly learn the cheapest rates in existence on all kinds of shipments, the fastest methods of shipment, the best methods of protecting shipments from loss and damage, and how to organize and manage a traffic department for maximum results. The book also tells what hundreds of other men have accomplished as a result of the study.

The new profession of traffic management is in its infancy. The possibilities today—great as they are—are nothing compared to what they will be a year from now. If you are at all interested in getting into this highly profitable field, paying salaries of \$2,500 to \$10,000 and more, be fair to yourself and write for the remarkable book now offered free by the Association. In writing, please state whether you are a beginner or whether you have had previous traffic experience, and give your present age and occupation. Address, American Commerce Association, Dept. 911, 206 S. Wabash Ave., Chicago, Ill. (American Commerce Building.)

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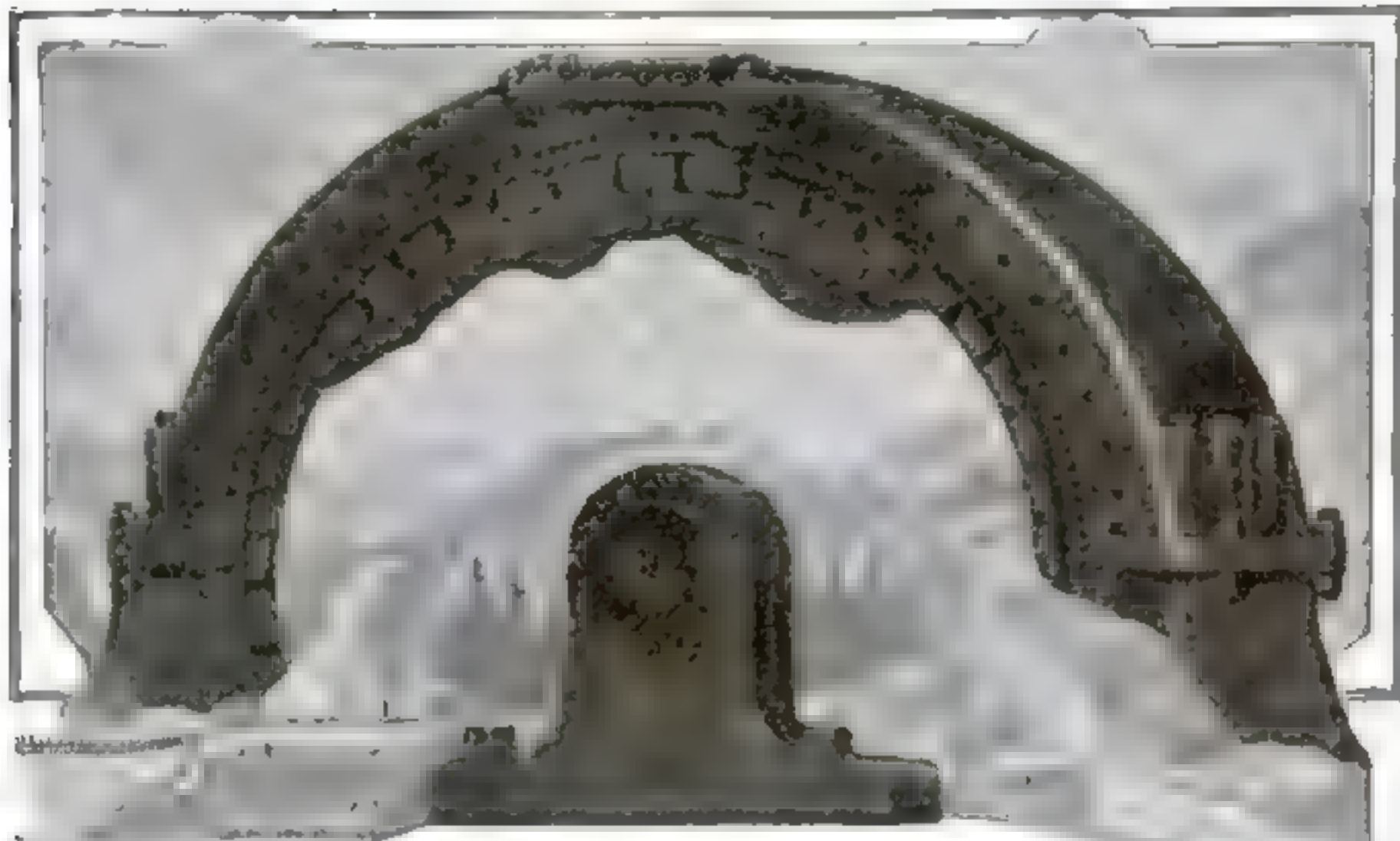
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I believe every teacher of mechanical science or manual training should use the POPULAR SCIENCE MONTHLY as a service book. My students take a great interest in the lectures taken from it.

T. W. Kerley, Teacher of Manual Training, Estherville High School, Estherville, Ia.

The magazine was read more by the boys than any other on our reading table.

Ralph E. Roycroft, Detroit, Mich.

For use in supplementing a high school physics or chemistry course I think POPULAR SCIENCE MONTHLY has no superior in the line of current literature.

George E. Davis, Teacher of Physics and Chemistry, High School Institute, Mishawaka, Ind.

POPULAR SCIENCE MONTHLY is very popular with our boys, in fact so much so we find they prefer reading the magazine to studying their regular school work. Personally I find the magazine helpful and interesting. New ideas are continually coming up within its covers, and suggestions for rearrangement of work.

L. D. Whiting, Supervisor, Manual and Physical Military Training, Falmouth, Mass.

We use the POPULAR SCIENCE MONTHLY regularly in our department of the school, and many of the boys I notice bring in copies of it almost every month, and figure and work on some of the projects.

C. R. Bernard, Supervisor of Manual Arts, Salida High School, Salida, Colo.

Science is a living, vital subject. If one teacher more than another should be up to date it is the science teacher. I think that POPULAR SCIENCE MONTHLY is the best magazine on the market for supplementary science material.

Albert Early, Principal, High School, N. Plainfield, N. J.

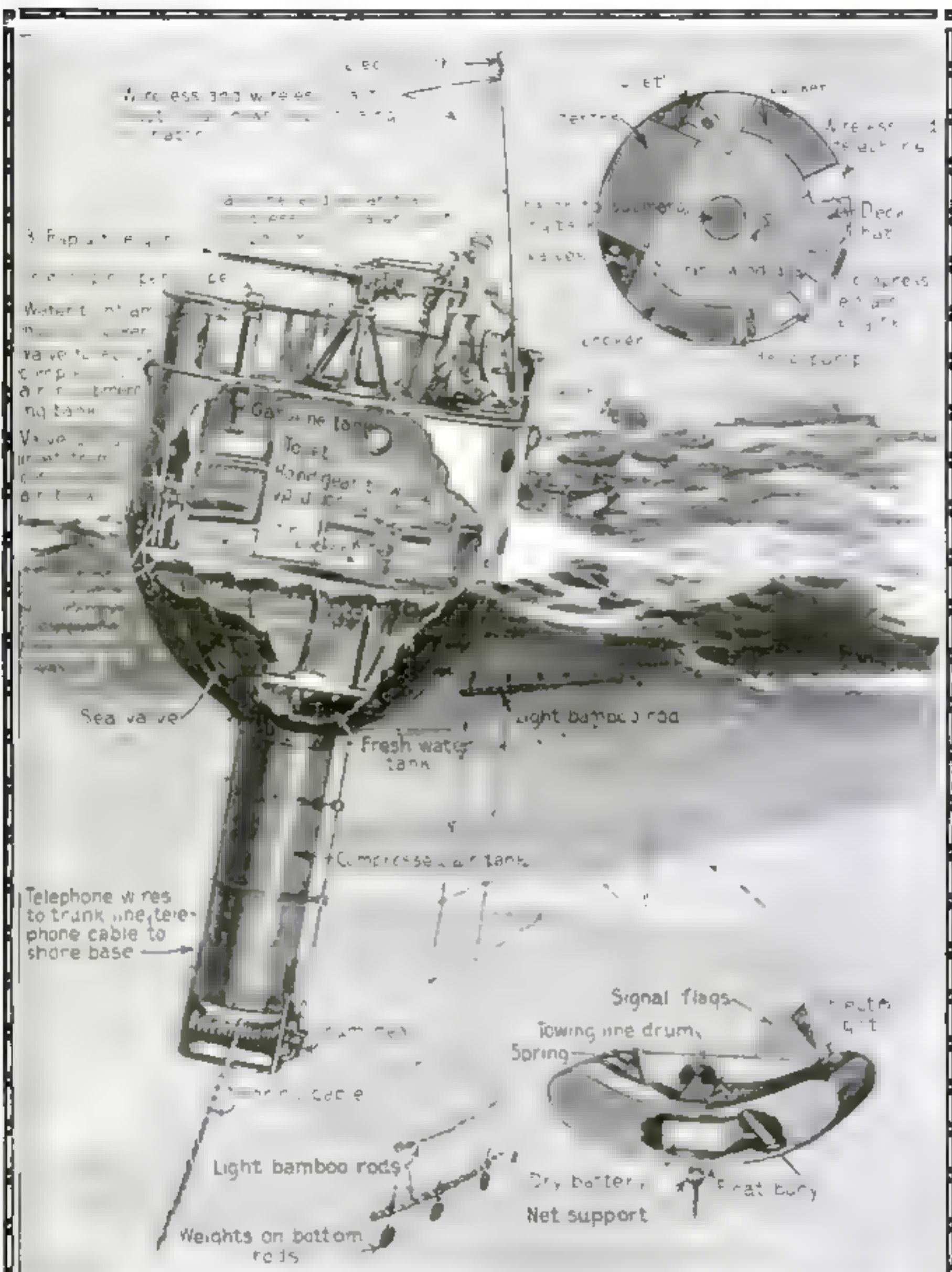
The POPULAR SCIENCE MONTHLY taken by the school is literally read to pieces by the first year and third year pupils. It is referred to very frequently in class, and is of material help.

C. B. Roote, Headmaster, High School, Northampton, Mass.

The POPULAR SCIENCE MONTHLY is the most popular of all magazines, especially with the boys of the 8th-9th-10th years (highest grade and first two high school years) in school.

Burl W. Alverson, Principal, High School, Dexter, N. Y.

Fighting Off Submarines with Armed Buoys



The Submersible Buoy and How It Works

As soon as the submarine strikes a light net held in the water by bamboo rods, a telltale flag appears on a little float by day and an electric light flashes by night. The lookout on the deck of the buoy knows that a submarine is near. At once the wireless outfit is brought into play to notify a patrol. If the buoy should be attacked, the crew go below, open the sea-valve, sink out of sight and telephone to shore.

Popular Science Monthly

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November, 1917

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Annually

The Gun-Buoy for Repelling Submarines

It has living quarters for four, telephone connections, periscopes and a rapid fire gun—all the modern marine conveniences

A SERIES of huge buoys, each of which carries a gun and on each of which four men can live for many days, is the latest solution which has been offered to cope with the submarine menace.

As the picture on the opposite page shows, each buoy has an upper deck on which a three-inch rapid-fire gun is mounted, living quarters below the gun-deck, a tank below the living quarters, which tank is to be filled with water in order to sink the buoy, and finally, a cylindrical compressed-air tank at the bottom. The buoy itself is about sixteen feet in diameter and about twenty feet deep from the gundeck to the top of the compressed-air tank. At the bottom of the compressed-air tank is a cable drum and winding gear. The anchoring cable is wound around this drum. When the buoy is to be rapidly submerged, its sinking can be hastened by winding up on the drum gear, the extra downward pull assisting the water admitted into the submergence tank. A hand gear is provided in the living quarters to facilitate the winding up of the mooring cable.

The buoy is equipped as completely as a boat or as a submarine itself. It has a periscope, which can be used when the gun deck is just awash; a wireless outfit; telephone connections with a land station, a microphone for picking up the hum of a submarine's motors under water, and a small gasoline engine with attached air compressor, which is stored in a watertight compartment and which serves the purpose of filling the compressed-air tank.

A whole series of these buoys is to be used. They are connected by a telltale net of very light construction, the meshes of which are about twenty feet square. The nets are to be made in units measuring forty feet by two hundred. Light bamboo

poles suspend the nets in the water, the bottom pole being weighted so as to keep the unit upright. The upper bamboo pole is connected with a little float which is shown in the detail drawing on the opposite page. The float carries a telltale flag and an incandescent lamp, the one to be used by day and the other by night. As soon as a submarine strikes the net, the flag is thrown up and the light flashes.

Each little float is attached to the top of each net unit. The connection between the float and the net is such that the slightest tension upon the part of the net will destroy the connection. A line leads from the net unit to the little float through a watertight tube and to a drum on which it is reeled. As soon as the submarine strikes the net unit, the float rises and the line is unreeled. When the whole line is unreeled a latch attached to the drum is released and that, in turn, unlocks the flag, which is forced up by a spring. The pole of the flag throws a knife switch so that the battery is simultaneously placed in circuit with the electric light.

The buoys are in direct communication with one another as well as with the mainland and the patrol fleets so that they are able to give instant warning of the presence of a submarine within their radius of action. Normally each buoy would float just above the surface with its hatch open. One man would be stationed on deck as a lookout; another would operate the wireless apparatus; a third would stand ready to perform any necessary operation; a fourth man would be sleeping.

The cost of making the buoys and net units is small compared with the building of destroyers and submarine chasers and steel nets. Moreover, they can remain at their stations for a far longer period than a patrol fleet can remain at sea.

A Merry-Go-Round with Which German Soldiers Amused Themselves

"**A**ROUND the world in forty days," is a part of the legend which appears over a ramshackle merry-go-round made by the Germans on French soil. For all we know, this may have been the German slogan at the beginning of the war. The merry-go-round is now in the possession of the French.

Two cast-off wheels with the axle form the main part of the makeshift affair. The elaborate structure on top is a giant spoked wheel placed over the ordinary wagon wheel. The seats are suspended by wire—rope being as scarce as copper.



French Official Photo

A German merry-go-round made out of odds and ends on French territory and later abandoned

Keep Livestock Away from Railroad Tracks and Conserve the Meat Supply

DURING the twelve months ending June 30, 1917, the Southern Railway system alone paid out more than \$200,000 in judgments to farmers for animals killed on the railroad's right of way. President Harrison, of that system, points out that if the farmers would prevent their animals from straying over the tracks they would help solve the war problems. In the first place, the animals killed are a total loss as far as the food supply is concerned. Then, the sum paid by the railroad in recompense even at the present prices of equipment, would buy more than one hundred standard box cars capable of handling at a single load more than 3,000 tons of freight, thus tending to relieve the freight congestion. Here, then, is a chance not only for the chuckling farmer but for the comic artist and the jokester to relinquish a source of income for patriotism.

The Suitcase Talking-Machine. Take It Along on Your Travels

WHAT to do with the talking-machine when you leave the city for the summer has been solved by Arthur Stech-

bart, of Chicago, Illinois. Like the dog, the cat, the pet parrot and your wife's new hats, you take it along with the rest of the hand baggage. Being a portable machine in the shape of a small suitcase, it can be carried from place to place without injuring the mechanism or destroying the records, which do not have to be carried separately

but are packed away within the machine itself.

Brass knobs protect the corners and add to the suitcase appearance of the closed machine. The handle of strong padded leather is placed just exactly as it would be on a regulation suitcase. But the interior is exactly like that of the small-sized talking machines. The record chamber is on the under side of the hinged cover of the machine casing. A recess is cut into the top board of the casing to hold the needles and needle-carrier.



Record storage compartment

The talking-machine is a small-sized suitcase, with a chamber in the cover to hold records

A Perfect Bread Slicing Machine for the Commissariat

A NEW bread-slicing machine recently devised by two Washington men—W. H. Garlock and W. J. Stubbe, of Seattle, slices an entire loaf at one operation without crushing, tearing, or breaking the slices.

A number of knives, supported in two frames, are operated vertically and simultaneously but in opposite directions. When one set of knives is traveling up, the other set is traveling down. By this arrangement the friction in the slicing operation is counteracted and the softest and hardest baked loaf can be sliced equally well.

The workman operates the knives by pressing on a treadle. A second operator at the rear or side of the machine then moves a lever that operates a mechanism that ejects the slices of bread. Meanwhile a release of pressure on the treadle permits a weight to restore the carriage of the machine to its initial position, and a plate is automatically drawn from under the slices, allowing them to roll into a receptacle beneath. When delicate cakes are cut the slices are lifted out by hand.



The bread slicer is operated by a treadle. A whole loaf is cut at one operation.



To a submarine a few miles distant, the ship above seems to fade away into a glittering, shimmering haze!

A Leopard Ship of the Sea—Even the Masts Are Spotted

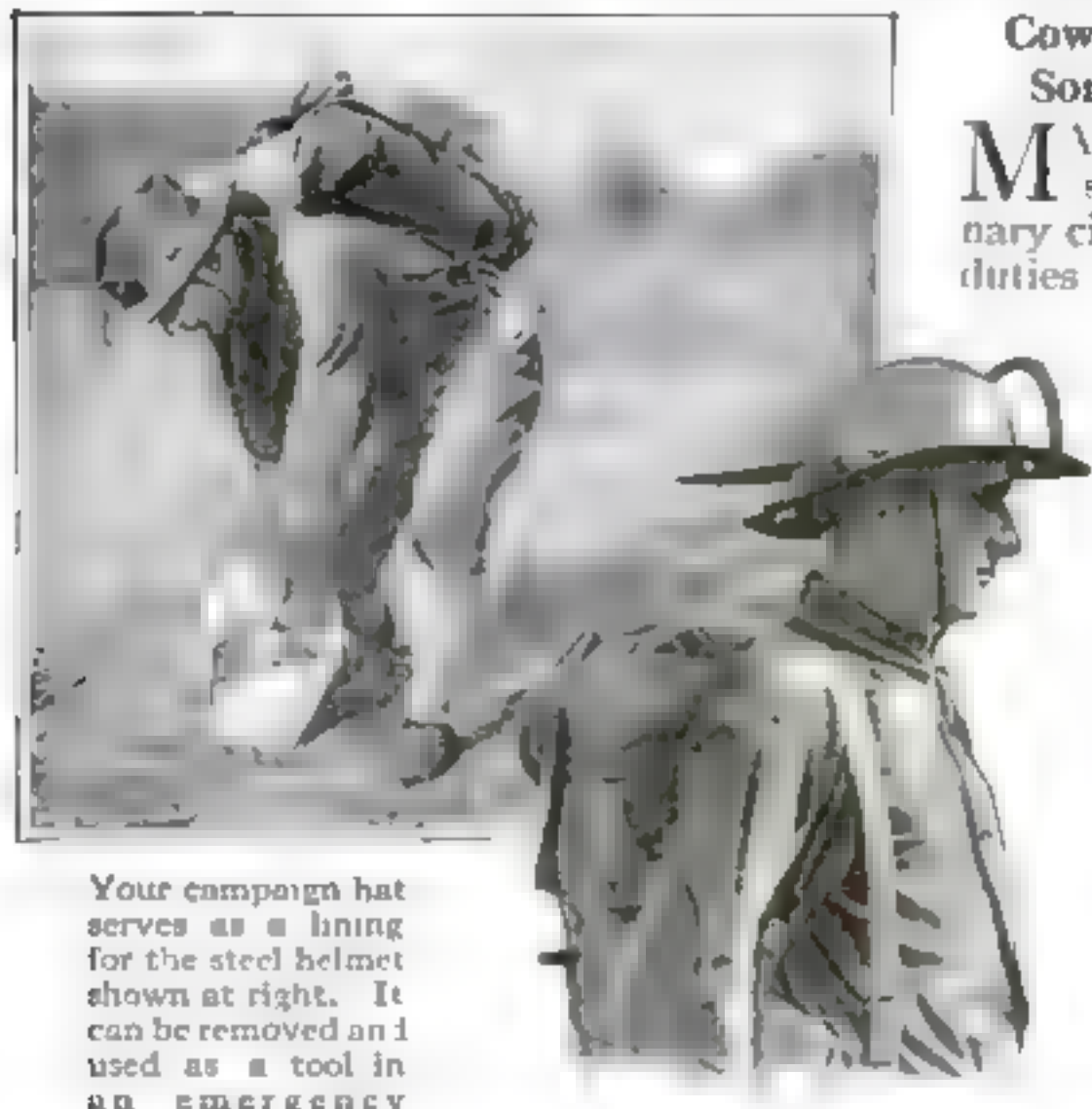
FOOLING the enemy is a remunerative and interesting pastime with the Allies. They have their camouflage on land; now comes the camouflage of the sea. A ship is painted with spots which fade out into a glittering and shimmering haze in the sunlight. A submarine commander one or two miles distant might look straight at the ship and never see her.

The spots are of light gray and navy blue, which, even on a sunless day blend with the waves of the ocean. The indistinct outline which this gives makes the ship a poor target.

Fat People Are Unpatriotic. Give Up Your Fat to the Nation

ACCORDING to statistics compiled by the Life Insurance companies, there are, between the ages of thirty-five and fifty-five years, a vast number of people who are hoarding and accumulating fat enough to supply energy equivalent to that of 690,355,533 loaves of bread, enough to supply an army of 3,000,000 men for sixty days. A man who is forty pounds overweight is carrying on his body the equivalent in fuel value of 135 one-pound loaves of bread.

If the guilty ones would cease this accumulation (which they are willing enough to do) it would release much-needed fuel foods, such as wheat, corn, oats, barley and rye. There are two ways of surrendering this fat. One is by judicious exercise and the other is by substituting other foods for the fat-building kinds.



Your campaign hat serves as a lining for the steel helmet shown at right. It can be removed and used as a tool in an emergency.

Cowards in the Army Are Rare. Some Are Merely "Deficient"

MANY a man is mentally unfitted to stand the strain of war. In ordinary civil life he would be able to do his duties successfully but under the stress of modern warfare he would collapse. Considered a coward he would not in reality be responsible for his actions. In order to weed out men who are unfit for the work of the war a unit of thirty beds will be attached to each base hospital in the training camps. The men assigned to these beds will be those accused of cowardice by their mates. They will be under the watchful eyes of physicians trained to detect signs of mental weakness. Those who show such signs will be rejected. This will save many men from severe punishment for cowardice and weed out the unfit.

A Versatile Helmet. Take It Off and You'll Have a Shovel

WHEN Leonard D. Mahon, of the Washington, D. C., Detective Bureau, designed a helmet with a detachable lining he had more than a helmet in mind.

Unfasten his helmet from its lining and take it off. Behold! You are still wearing a hat—the regulation campaign hat, upon your head. The campaign hat is itself the lining! The steel shell you may put to any of four unusual uses. If you should be pressed hard by the enemy, you can, as a last extremity, employ it as a hand spade and intrench yourself in a rifle pit. If you are on the march, on the other hand, it will serve you as a wash basin for face and hands or for your tired and aching feet. Especially will this improvised basin be necessary when you come to a stream where you may take a much-wanted drink.

In camp, the versatile helmet will make a good water bucket, or it may be used for bailing.

The Mechanical Cigarette-Filler. It Supplies Its Own "Makings"

NOT since the first safety razor has there been any novelty invented which gets so close to the heart of a man as this mechanical cigarette-filler, invented by Dr. Edward P. Delevanti, of New York city. The device is a pouch made of nicked steel or strong leather, in which rice paper, tobacco (your favorite brand) and matches may be kept. At the bottom of the pouch is a groove-like arrangement into which just the proper amount of tobacco slides down into the rolled

paper, which you hold in position to be filled. A metal plunger, or rammer, packs the tobacco in the paper roll.



You can make a perfect cigarette in a blowing gale with this device without spilling a particle of tobacco.



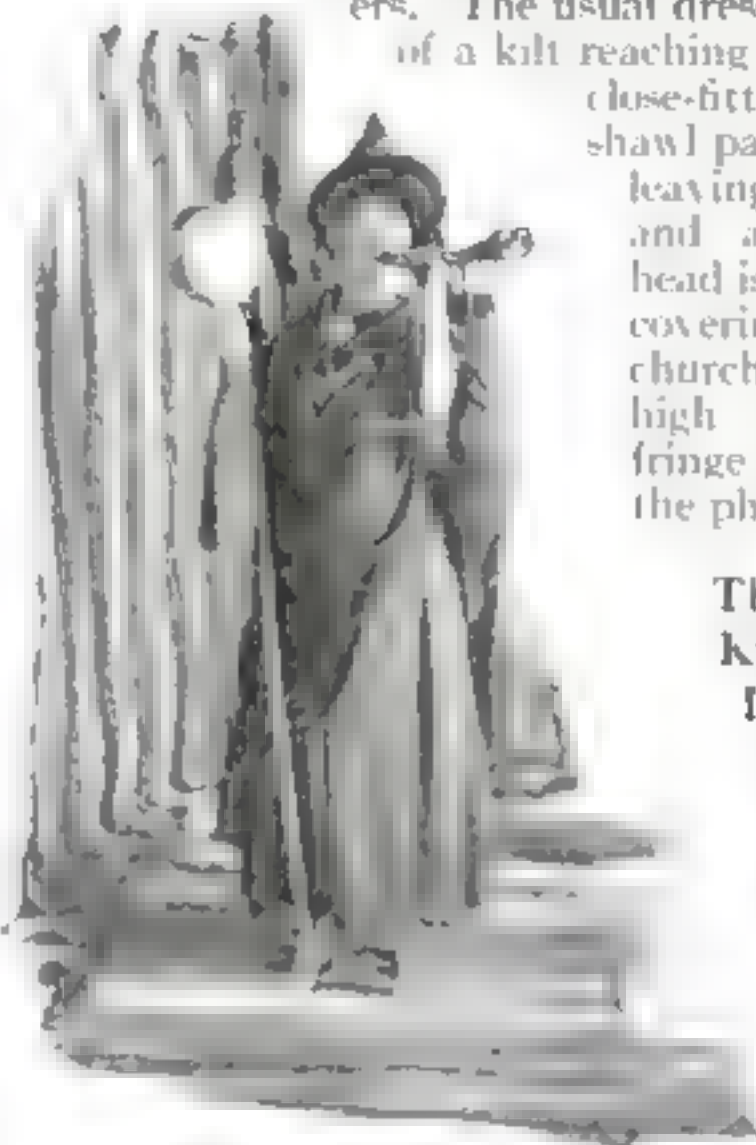
His Drum Is Made of Human Skin and His Trumpet of a Thighbone

LAMA, meaning "a superior one," is the name given by the Chinese and foreigners generally to the Buddhist monastic order in Tibet. In Tibet, however, the word is reserved for the monks who have not only taken the highest theological degrees, but who have led saintly lives and become famous for knowledge. Lamaism is a form of Buddhism practiced by the people of Tibet. In lamaism, magic and mysticism play such a commanding part that its relation to Buddhism can be recognized only with difficulty. The monks of Tibet are believers in the efficacy of prayer. They use a rosary such as that worn by the lama in the photograph. The rosaries are made of various kinds of wood, shell, sections of human skulls, and various kinds of odd seeds.

The drum and small trumpet shown in this picture are used in ceremonies connected with the exorcising of evil spirits. The drum is usually made by joining at the tops the domes of two human skulls, the drumhead being made of human skin. The beaters are suspended from cords and the drum is sounded by smartly rapping the beaters with the hand against the drumhead. The small trumpet is made from a human thighbone.

Among the most important objects used by the lama in church ceremonies is the vajra, or thunderbolt, which is the small metal object at the left elbow of the lama in the photograph. The Nepalese scriptures say that a contest once occurred between Buddha and Indra, in which the latter was defeated, and had wrested from him his chief and peculiar instrument

of power, the vajra, or thunderbolt, which was appropriated as a trophy by the victor, and has ever since been adopted by his followers. The usual dress of the lamas consists of a kilt reaching down to the ankles, a close-fitting waistcoat, and a shawl passed around the body leaving the right shoulder and arm uncovered. The head is shaved, and no head-covering is worn except in church ceremonies, when a high yellow hat with a fringe such as that shown in the photograph, is worn.



The lama with his ceremonial outfit which he uses in exorcising evil spirits

The Favorite Pocket-Knife of the Jackies. It Is a Century Old

OCCASIONALLY we come across some article of manufacture which has been improved upon year after year, only to return again to its original state as the most desirable. This is true of

the pocket-knife. You will find it in all degrees of perfection and ornamentation, but the style most approved at the present moment is that of the old navy knife—invented no one knows how long ago.

This knife is shown in the accompanying illustrations. It is the instant action, drop-out type, and is made in two styles, either of which the jackie prefers above all modern pull-out and push-button types. The blade simply slides in a groove so that it is opened by the same movement which jerks

it out of the pocket. When it has been fouled from long usage, the entire blade can be taken out and cleaned. The jackie prizes its simplicity when he is up aloft, with only one hand free, and when his fingers are stiff and numb. At such times any other kind would be useless.



Two types of old-fashioned knives which are more popular with the sailors than any modern specimens

The National Champion on the Flying Rings



This figure, the one-arm back lever, is easy for James Gleason, the national champion on the flying rings. But you'd better not try it until you've practiced

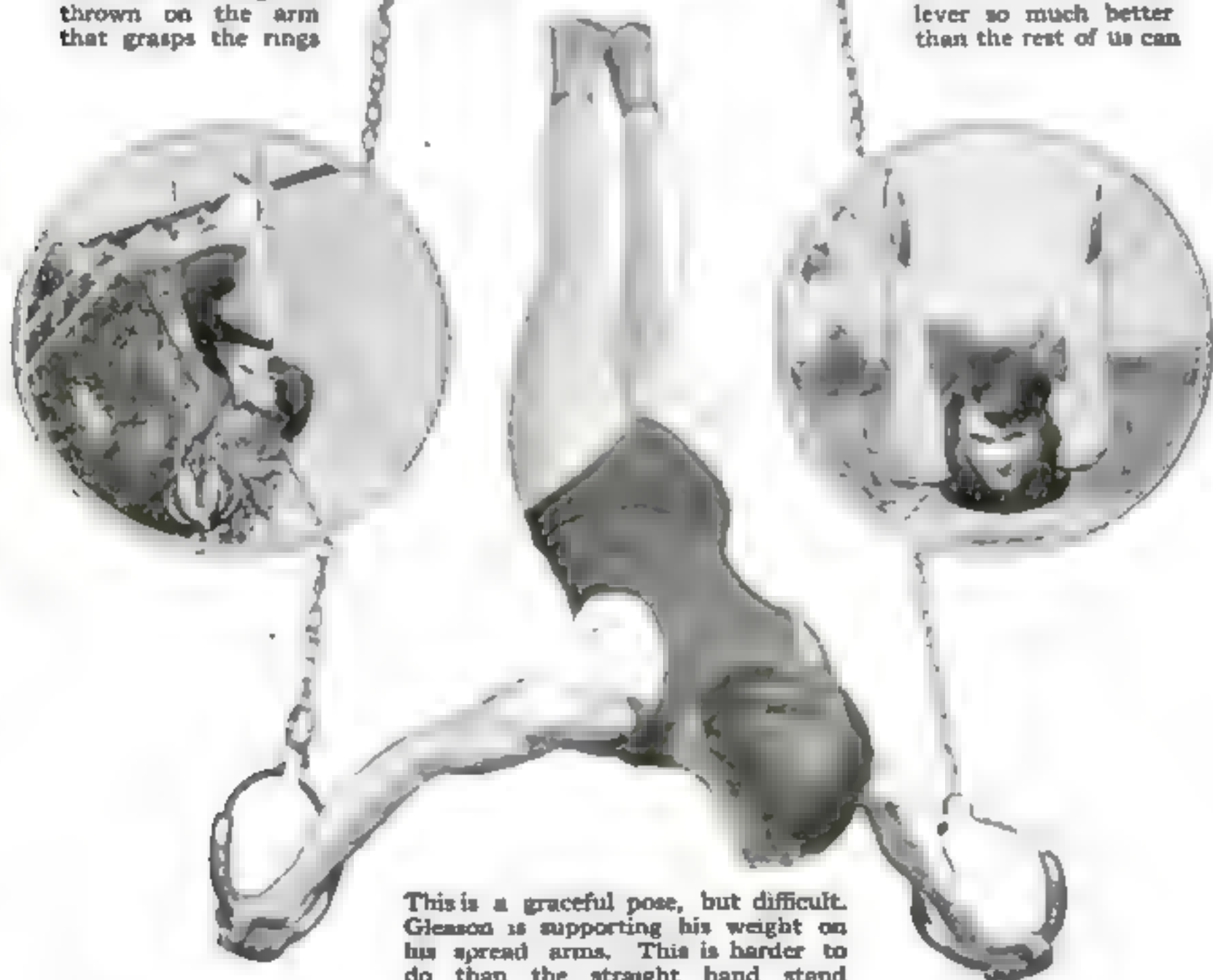


The two-arm front lever. The weight is borne on one ring with both arms. The trick lies in balancing the body with the arms at the angle shown here

Below: Here we have the one arm hand stand. Both rings are used and the weight is thrown on the arm that grasps the rings

The front rest. Both arms are used and the body is raised and held perfectly rigid

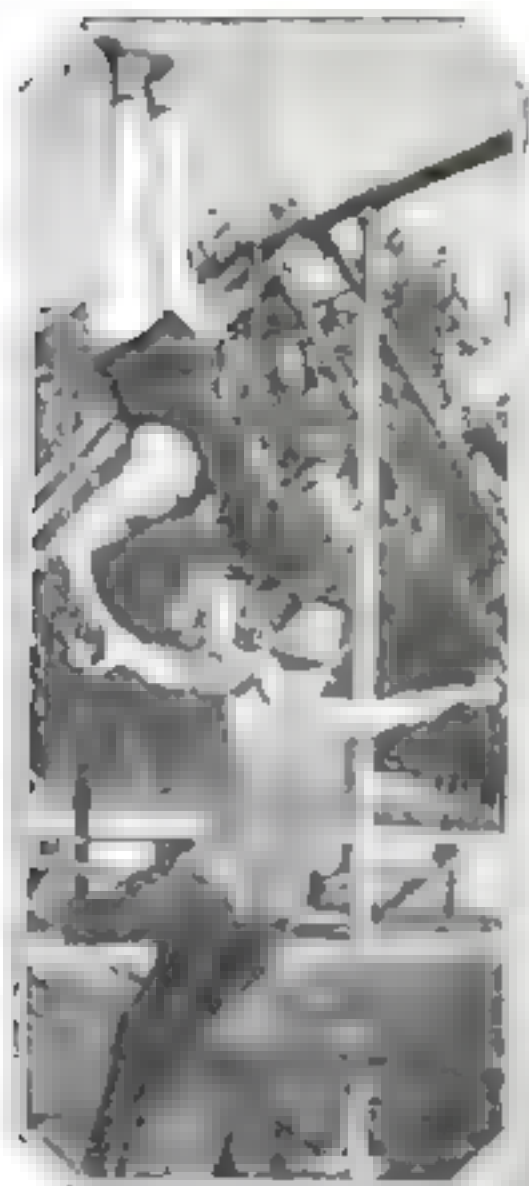
Below: Gleason is looking pleased, probably because he knows he can do the back lever so much better than the rest of us can



This is a graceful pose, but difficult. Gleason is supporting his weight on his spread arms. This is harder to do than the straight hand stand

Poses Obliging for Our Admiring Readers

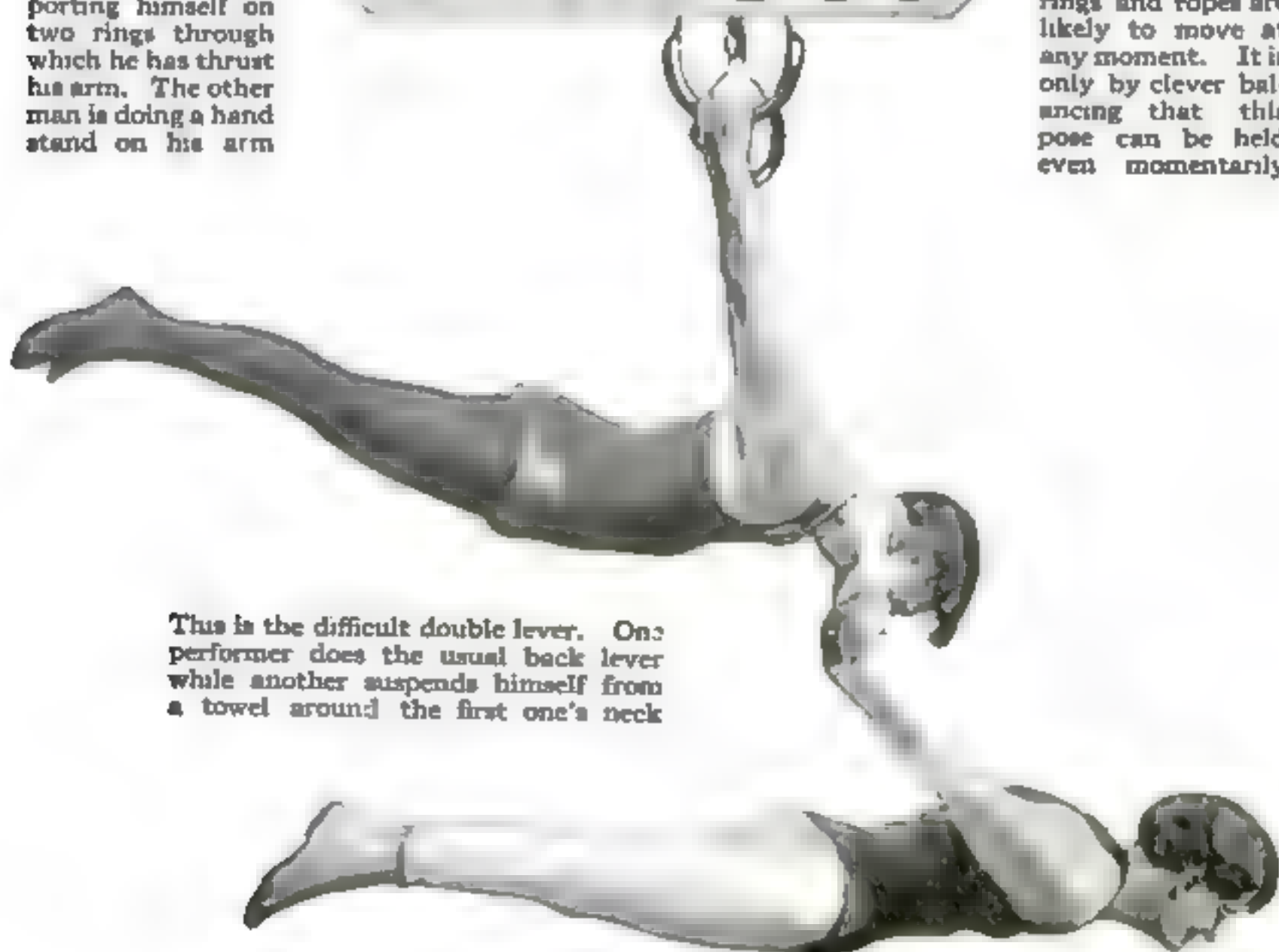
When you get to the point where you can do easily the shoulder stand shown below you will know you are getting on. In this you can't depend on your hands



Here is one you'll have to practice hard to master. One man is supporting himself on two rings through which he has thrust his arm. The other man is doing a hand stand on his arm



This trick, which is the hand stand, calls for fine poise. The rings and ropes are likely to move at any moment. It is only by clever balancing that this pose can be held even momentarily



This is the difficult double lever. One performer does the usual back lever while another suspends himself from a towel around the first one's neck

There Are Many Ways of Picking Up a Living

Like the vendor of Seville pictured on page 654, the milkman in Chili doesn't bother about a wagon to deliver his milk. The milk cans are carried in sacks over the horse's back and the milk is measured out with a dipper straight from the can to the consumer. In some parts of Chili the donkey takes the place of the horse as a milk-carrier



When W. C. Grant lost his arms braking freight in the West Buffalo freight yards he forgot about misfortune and became a street musician. He had a special instrument made for him, consisting of pipes mounted on a metal support. By binding the stumps of his arms with cloth and by rubbing rosin on the cloth, he was able to extract music from the pipes. He has played in the streets of all the big towns from coast to coast



Two Massachusetts boys washing out riches, but the mineral is lead instead of gold. A gun club shoots over the mud flat and the boys collect the shot from mud



When a steamer heaves in sight near Jamaica it is besieged by native traders who are anxious to dispose of young monkeys that have been trained and birds of brilliant plumage for a little silver. They approach the ship in canoes and small boats

Without Actually Working—Take Your Choice



Negro divers of the West Indies. Throw fifty cents into the water and they will dive down and get it out of the glistening sand into which it falls, swimming clear under the ship and coming up on the other side to inveigle you into throwing another



Steeple jacks will tell you that they don't take chances they let the other fellows do that. Here one is disentangling a flag twenty one stories above the street. Because their work involves such danger their pay is high



In Caraccas they sell lottery tickets like postage stamps. Once in a while somebody is allowed to win

John B. Riley, of Lancaster, Pa., playing on two instruments at the same time. He is 75 years old and makes a good living

The portable oven vendor of the east side, New York, who can sell you a hot meal for a few cents



W. K. A. L. L. E. T. T. E. R. S.
L. E. T. T. E. R. S. W. K. A. L. L. E. T. T. E. R. S.
L. E. T. T. E. R. S. W. K. A. L. L. E. T. T. E. R. S.
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Is Hard. Everywhere ious Medical Traps in Ensnared and Betrayed



"Something's the matter with my heart," protests the slacker. The doctor takes his blood pressure. The heart action is perfect. Another slacker goes to France.

He said he was deaf. They dropped an iron chair. He never moved. "You are faking," said they. "A deaf man would jump from the vibration."

Baths Without Bathtubs and Milk Without Dairies

A be-soaped Ceylon youngster getting the bath that has probably been promised him for fully five months or more

The mother takes a bucket of water and a cake of soap and does the job quickly and thoroughly right in the middle of the road



In Seville, Spain, they never bother about certified milk when they can get it delivered to their doors, warm and fresh from the cow herself. After she has yielded her daily quota of milk the cow is led to pasture for the remainder of the day. The milk is sold by the glass, pint or quart. Note the measuring cup behind the ears

Ancient Cliff Dwellings Near Santa Fé



Recent excavations in the Canyon del Rito de los Frijoles show us how cliff dwellers lived. Quantities of curious specimens of pottery were found

A village excavated in the Canyon del Rito de los Frijoles near Santa Fé. The dwellings are arranged in the form of a horseshoe about 115 feet in diameter



Shooting Irons and Buoys to Save Your Life



Photo by
L. J. M. G. G.

A soldier who cannot swim may still be happy in the water if he wears this new life preserver. He can shoot with both hands and smoke besides. He knows he won't drown.

Blowing up the water jacket. When deflated it takes up very little room and weighs only one pound. It will keep a man afloat indefinitely.



A sharpshooter wearing a water jacket used by British Tommies when fording streams. He is able to use his rifle without getting it wet. If he can tread water one man wearing this life preserver can easily support six men.

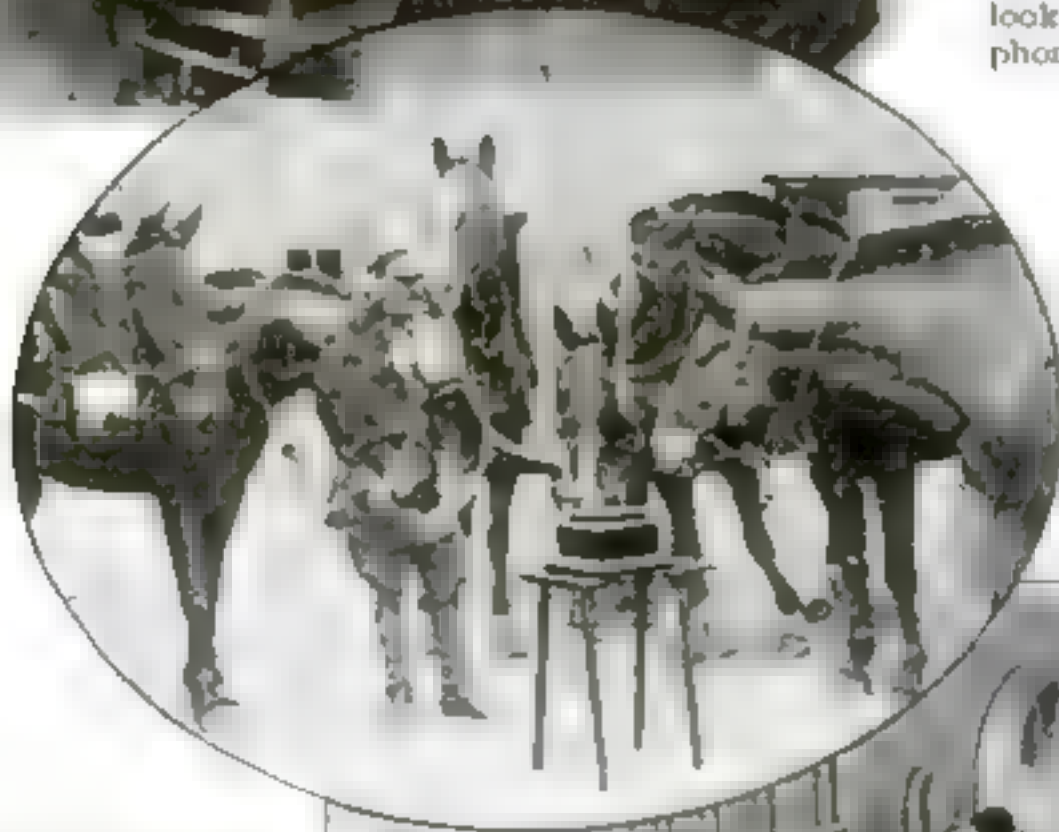


Making the Phonograph Work

Below: Music history at Ann Arbor was always a pretty dry subject until the instructors hit upon the happy idea of illustrating their lectures by phonograph. Now no one cuts that class



As for recruiting, that's where the phonograph plays a star part. Just look at the crowds listening to the phonograph—and the orator—of the



Below: Dumb-bell exercises get under way with lots more vim when the phonograph plays. This picture shows modern ideas in practice at Waynesboro, Pa.

Above: An English army officer discovered that in corrigible horses may be made tractable by music. The photograph shows a group of "bad uns" getting in good humor by listening to the phonograph

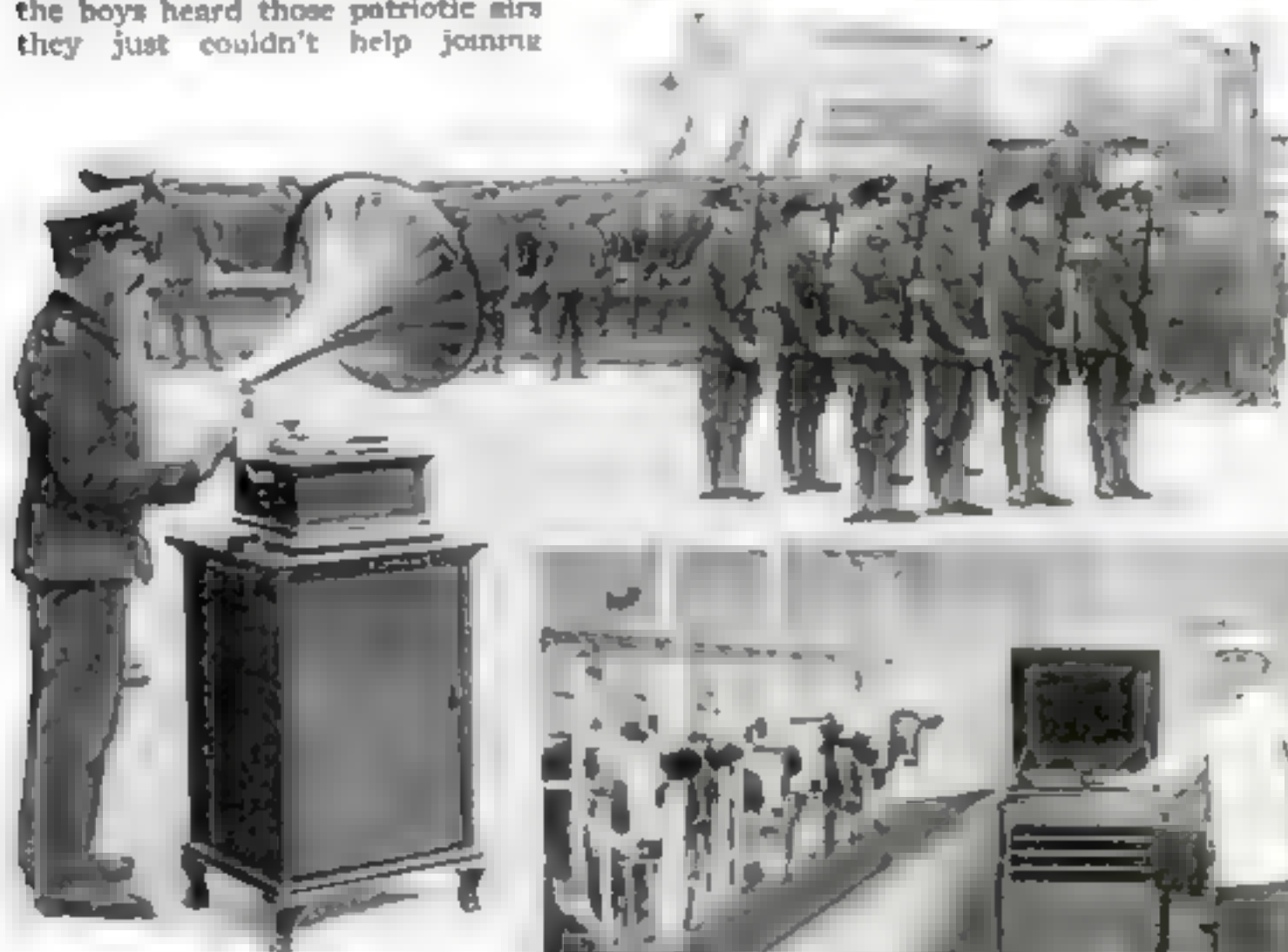


The Inspiration of Canned Music



Recruiting Station at Fifth Avenue and 42nd Street, New York. When the boys heard those patriotic airs they just couldn't help joining

Out in Rutland, Vt., they teach stenographers to typewrite to music. They get up more speed to the tune of a popular song than they ever did to an unpopular dictation lecture




At a recruiting meeting in charge of Captain Rees, of the Royal Fusiliers, held at Trafalgar Square, London, a phonograph uttered all the words of command



Cows enjoy light opera. Play their favorite selections at milking time and you'll get a freer flow of milk as a reward

Some Astonishing Exploits of Tanks and



Recently Mr. Philip Gibbs reported a thrilling fight between a German airplane and a British tank. Of course, the airplane had the worst of it, for the tank was armored and impregnable to machine-gun bullets.

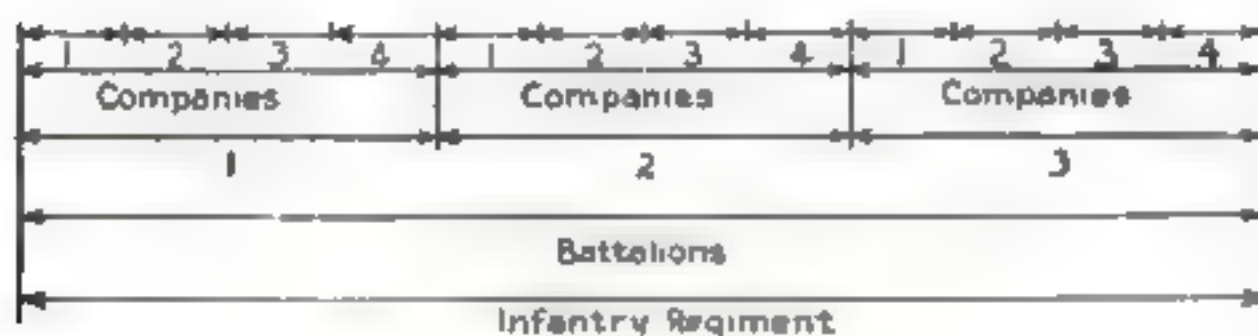
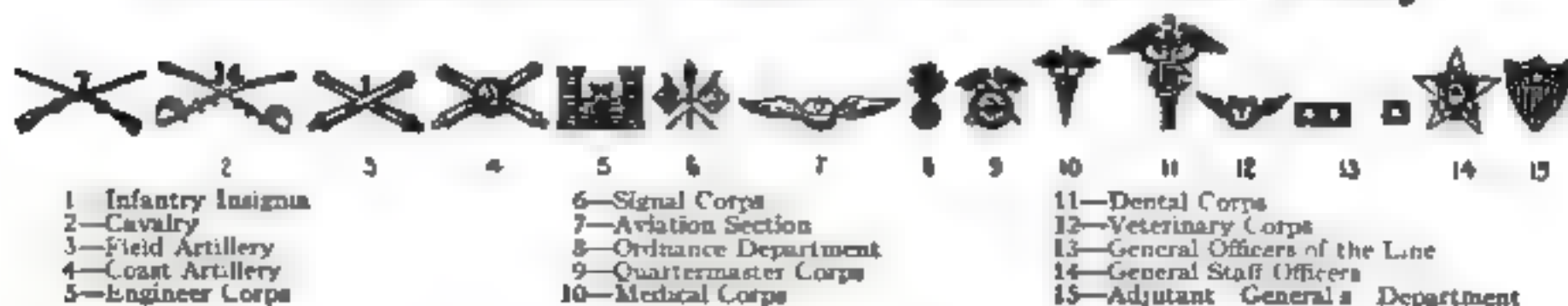
That the tanks are irresistible is demonstrated by Mr. Gibbs' account of the calm way in which one of them knocked from its rails a small locomotive which happened to be in the way.

Airplanes in This War of Terrible Wonders

"There was a boy of eighteen in one of our airdromes," writes Mr. Philip Gibbs, the war correspondent. "His first adventure was with a German motor car with two officers. He gave chase, . . . and followed. Then he came low and used his machine gun. One of the officers fired an automatic pistol at him, so the boy pulled out his own revolver. There followed the strangest duel between the boy in the air and the man in the car. The airplane was fifty feet high then, but dropped to twenty just as the car pulled up outside a house. The young pilot shot past, but turned and saw the body of one officer being dragged under."

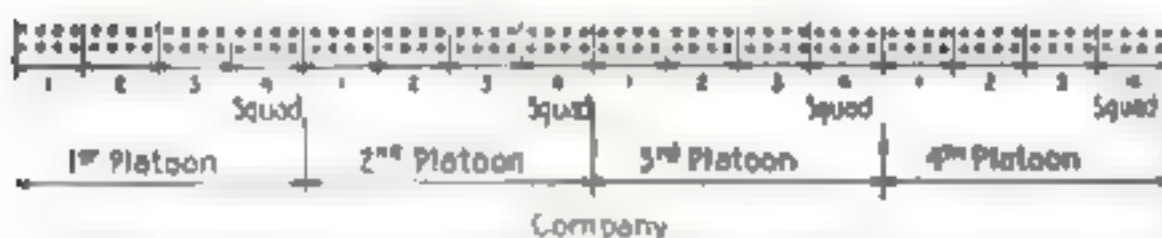


Who's Who and What's What in the Army



We now come to the subdivision upon which the entire theory of army organization is based. It is the infantry regiment which advances and wrests contested territory from the enemy. The other arms are subordinate to the infantry and are built up only with an eye to assisting the infantry in these tactics in any way circumstances may suggest. The battalions making up the infantry regiment are in charge of a major

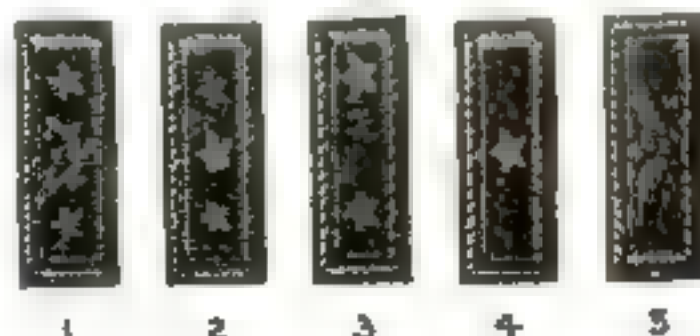
The War Department announced recently that a change was to take place in our army organization. The large units of the old organization were too unwieldy for trench warfare and they have been broken up into smaller ones, more flexible and easier to command. This explains the new army corps unit in the present system



At the bottom of every army is the private, and the group of six or eight privates which make up the squad. No group of men can be together without one of them being responsible. The corporal, who is simply some designated soldier in the squad, is a general leading a small army. He in turn is subject to the orders of the platoons commanders, who are lieutenants and sergeants. A captain commands the company



The automobile has had a tremendous influence in making present-day warfare as mighty as it is. Supplies are now brought up in great motor trucks four times faster than they could be with army mules

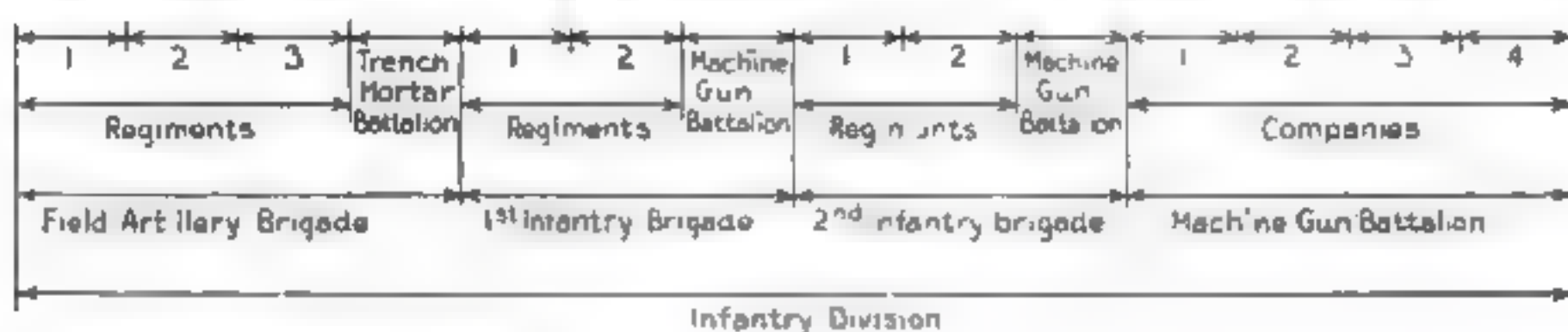


Shoulder straps which commissioned officers wear: 1. General; 2. Lieutenant General; 3. Major General; 4. Brigadier General; 5. Colonel;

Who's Who and What's What in the Army



- | | | | | | | | | | | | | | | |
|-----------------------------------|-----------------------------------|----------------------|-----------------------------|----------------------|----------------------|------------------|-----------------------|---------------------|--------------------|-------------------|--------------------------|--------------------------------------|---------------------------------------|------------------------------------|
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 16—Inspector General's Department | 17—Judge Advocate General's Dept. | 18—Detached Officers | 19—Adjutant General's Dept. | 20—West Point Cadets | 21—Philippine Scouts | 22—Indian Scouts | 23—Recruiting Service | 24—Recruiting Depot | 25—All Army Troops | 26—Service School | 27—Disciplinary Barracks | 28—Disciplinary N. C. O. Instructors | 29—Sergeants (Corporals, two stripes) | 30—Reserve Officers Training Corps |

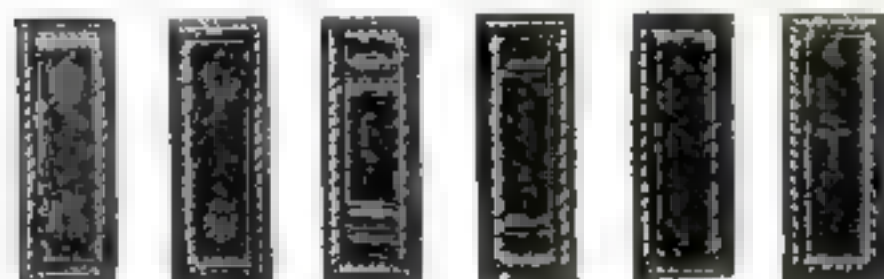
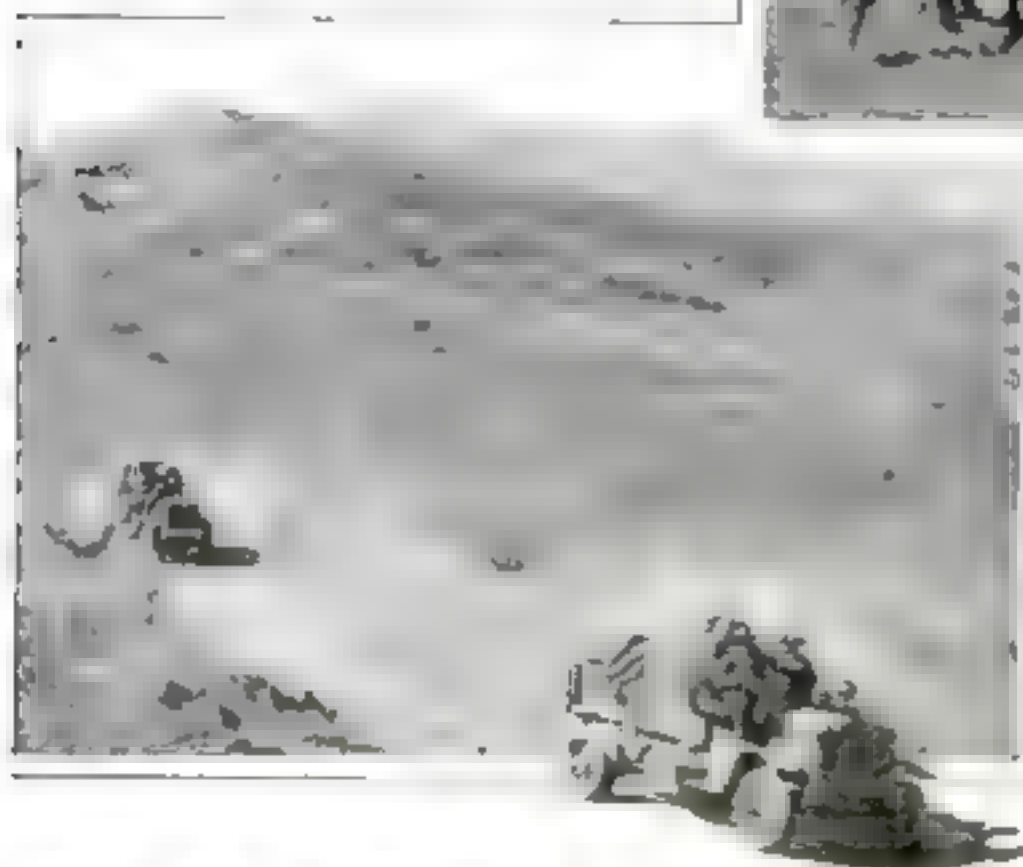


The former infantry division of nine regiments of infantry and three of artillery has undergone the most change. Five infantry regiments have been cut out and machine gun and trench mortar battalions have been added, so that the artillery strength has been increased considerably. The division, which once consisted of twenty-eight thousand men, has been reduced over thirty per cent. The Army General's Staff control brigades and regiments



The work of the signal corps is exceedingly important. The men of the wireless service follow the infantry in their advances and keep up the communication with the army headquarters

Modern armies are complex organisms, not so much because of the large organization of field forces, as on account of their many needs. Hence the necessity for a reliable transportation system



- | | | | | | |
|------------------------------------|---------------------|-------------|----------------------|------------------------|------------------|
| 6 | 7 | 8 | 9 | 10 | 11 |
| 6, Lieutenant Colonel (in silver); | 7, Major (in gold); | 8, Captain; | 9, First Lieutenant; | 10, Second Lieutenant; | 11, The Chaplain |



No matter of what service or what rank, every American soldier has an equal chance of winning the Medal of Honor. It is awarded by Congress for distinguished personal bravery or self-sacrifice that involved the risk of life. It is even more difficult to obtain than is the Victoria Cross



The glass-lined, steel laundry chute for use in hospitals and hotels. At right is shown the ventilator at the top, the plateglass-covered openings on each floor, and the cellar exit



on each floor. They are so fitted that they are airtight and prevent the escape of odors and infections while the chute is in use

A Machine that Moistens the Indoor Air

ONE of the greatest objections to artificial heat is the fact that it tends to make the atmosphere very dry. A certain amount of moisture is necessary to maintain healthful living conditions. When the atmosphere is sufficiently moist a temperature of 65 degrees is more comfortable than one of 70 degrees, and at night, when the heat is off, the house will not become as cold as it will when the air is dry.

A device has been perfected which will keep the house air moist. This is a receptacle which holds and evaporates water in such a manner that the moisture will be diffused into the air without condensing.

The apparatus measures about 20 inches in length and nine inches in height. It will evaporate three and one-half gallons of water during a day and an evening. This quantity of water maintains a humidity of 45 per cent in an ordinary residence.

The device may be connected with the water pipes and heating pipes of a house. The water supply is automatically regulated and the water is heated by the heating system. The apparatus may be used with steam heat, hot water or hot air.

The heating and water supply pipes are provided with valves so the moisture

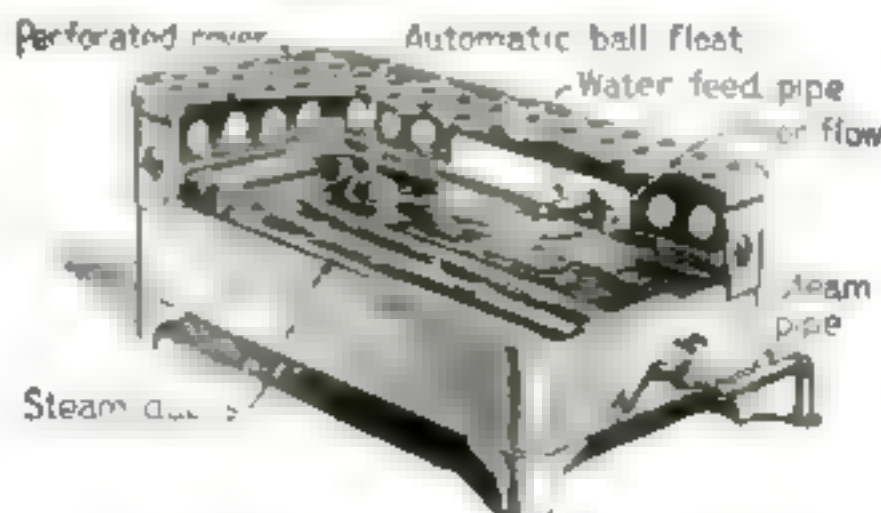
may be turned off at will. If the air is sufficiently humid so that it is not necessary to supply it with moisture, the machine may be used as a small radiator. This is accomplished by turning off the water supply valve. It will then give off heat without releasing moisture.

Sending the Wash to the Laundry Through a Glass-Lined Chute

A NEW type of laundry chute has been designed for the use of hospitals, hotels and other institutions where large quantities of soiled linen are handled. It is constructed of steel with a fused-in lining of glass enamel. This lining is particularly desirable because it is rust proof and will not absorb substances or odors.

The chute is supplied with a flushing ring at the top so it may be thoroughly and easily cleansed by a shower of hot water. An outlet through the roof permits ventilation. The chute may be aired by opening the bottom door which allows a strong draft to blow through it and out through the ventilator

Plate glass and nickel doors open out



A machine that keeps the air in the house as moist in winter as the outdoor air in summer



The inventor fails to tell how this man could inhale enough air to raise a snore if the strap were tight enough to hold the ball in place

Filtering the Snores Out of Sleep

How our inventors are wrestling with the problem of silencing the nasal nightingale

By E. B. Breuer

soft rubber flanges connected by a thin rubber strip, which is to be held between the teeth. One of the flanges is to be placed behind the lips. The other remains outside. The flanges are bigger than the mouth, and the device when in place thus constitutes an effective stopper. As mouths differ greatly in size, we assume that this is essentially a tailor-made device. The inventor leaves us in the dark on that

point. We must agree with him, however, that to the man who consents to wear one of the appliances, nasal music will become a lost art.

The inventor of the similar device in the center of page 667 is more lenient. His apparatus also is a stopper for the mouth, but it has a one-way valve. The valve, opening outward only, permits the expulsion of air from the lungs. Should the wearer attempt to inhale through the mouth, he will find himself surrounded by an utter lack of facilities for such an operation.

In such a case the valve closes instantly, the sleeper is obliged to inhale through the nose and another shattering of the silence is averted, or, as the inventor scientifically puts it, there is an absence of "the harsh nasal sounds commonly called 'snoring.'"

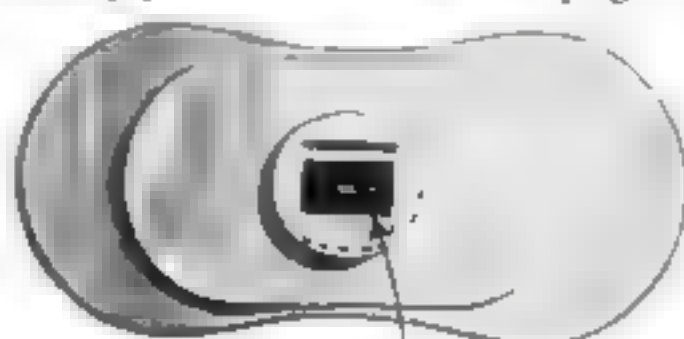
It remained for a Wisconsin investigator, whose device is illustrated at the bottom of this page, thoroughly to tame or domesticate the anti-snoring shield. His apparatus is supplied with flanges—to fit under the upper and lower lips. They are to keep the device from wandering from side to side. But the striking feature is a ring which protrudes from between the

UNFORTUNATE — because innocent — is the person who snores. But let him take heart! Science is on the job. The activities of the geniuses who would silence the snore have been widespread; their devices for restoring peace on earth and sleep to men take many forms. The amount of thought that has been given to the subject is amazing, and we may infer that many a midnight watt has been consumed in the search for a snore-silencer.

As the poet might put it, the triumphs by these workers scored were not attained by sudden flight, but they, while their companions snored, were toiling onward through the night—obviously not the oft-mentioned stilly night, else the incentive to work would have been missing.

The specimens of anti-snore devices shown here are separated into two classes.

The first principle employed, as the scientific foes of the snore would apply it, may be described as suffocation in varying degrees. Exhibit A in the center of this page is the simplest type. It is a modification of the idea that if a man can't breathe, he can't snore. Specifically designated, it is a plug for the mouth. It consists of two



Valve

Any snorer who defied this anti-snoring plug clamped in his mouth would do so over his own dead body, so to speak; that is, he would be suffocated in the attempt



This apparatus has a tether which prevents it from getting lost in case of a blow-out

lips when the device is in place. A string attached to the ring can be tied around the neck. This will enable the wearer to recover the shield in the dark in case he has a blowout. It will also keep him from swallowing or inhaling the apparatus should he overcome its resistance by a determined effort to break into nasal rhapsodies.

In the second class, the anti-snore devices are intended to keep a person from sleeping on his back, in which position the nasal soloist makes the welkin and adjacent hardware ring. Apparently the inventors who work along this line never slept on lumpy mattresses. If they had, they probably would have directed their thoughts toward some method of fastening the snorer, face up, on any one of the inanimate deformities of the bed.

In one of the illustrations at the bottom of this page is a simple application of this principle. A pad, either round or elliptical, is strapped to the small of the back by means of a belt. The idea is to keep the sleeper off an even keel and thus prevent his useless sounding of the fog siren. The pad, it is said by the inventor, will keep him listed either to port or to starboard.

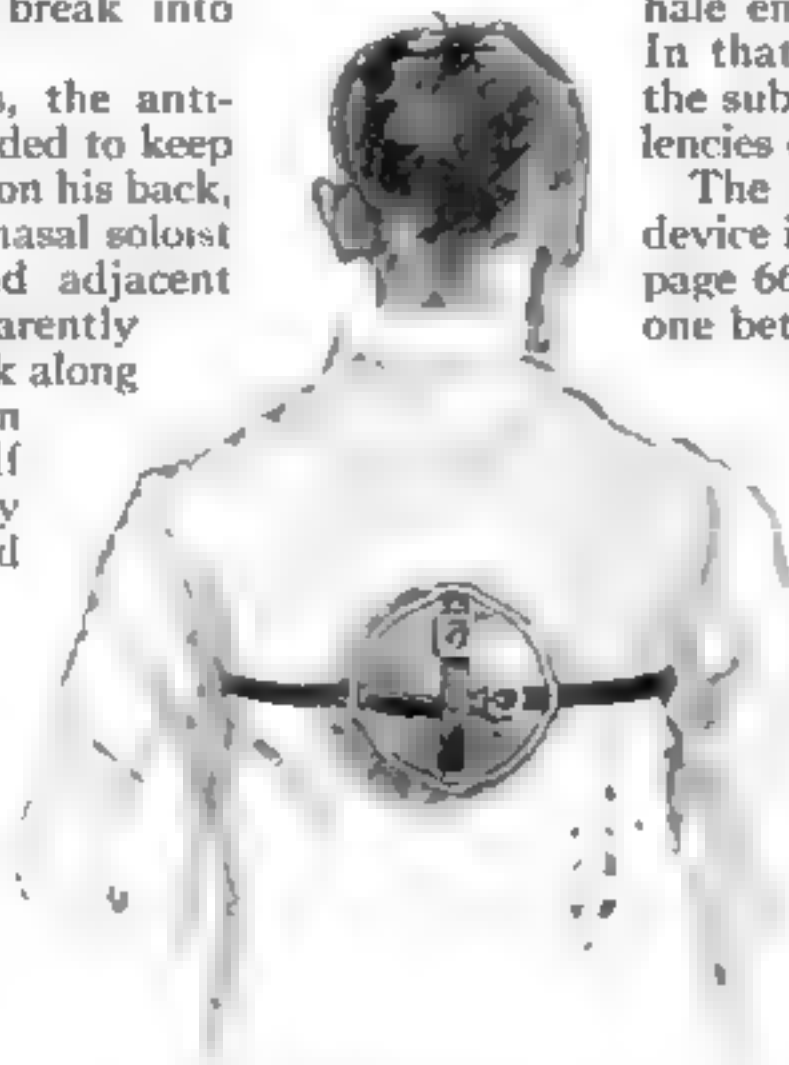
The ball-and-strap device opposite is almost a duplicate of the one described. The inventor, however, believes more punishment can be inflicted by strapping the back-breaking object directly between the

shoulders. He advocates the use of a rubber pneumatic ball to be fastened to the belt in such a manner that it will be neither punctured nor displaced. He fails to explain how a person with the belt strapped around his chest tightly enough to hold the ball in place could inhale enough air to raise a snore. In that, however, may lie one of the subtle and fundamental excellencies of his invention.

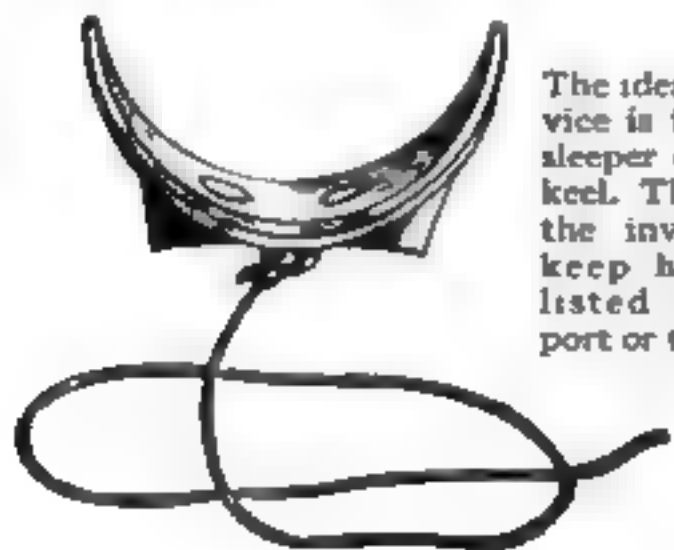
The genius responsible for the device illustrated at the bottom of page 667 goes his fellow scientists one better. He doesn't believe in half-way measures and is not afraid to say so. His scheme is to make life on the flat of the back so miserable that a snorer assuming such a position will wake up at least long enough to wish he had never been born. Incidentally, he combines a shoulder brace with the snore dispeller. The connection between snoring and shoulder braces is not immediately apparent, but it becomes so when one reflects that if a shoulder

brace won't keep a person awake, nothing will.

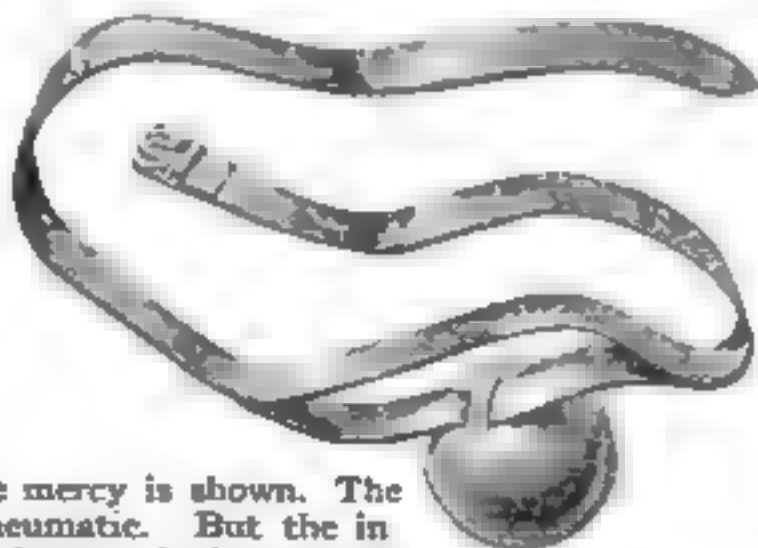
The refinement of torture, however, so far as this public benefactor could apply it to snoring, is embodied in the attachment to be fastened to the shoulder brace at the back. The attachment is a metal casting having several projections. Though spikes



It may be confidently stated that the wearer of this device would not snore for the simple reason that snores accompany sleep and for him sleep is altogether out of the question.



The idea of this device is to keep the sleeper off an even keel. The pad, says the inventor, will keep him always listed either to port or to starboard.



Here some mercy is shown. The ball is pneumatic. But the inventor emphasizes the importance of protecting it from puncture.

undoubtedly would be more effective, the inventor seems to have been overcome by a feeling of pity at the last moment, for he directs that the projections are to be tipped with balls or knobs "to prevent them from injuring anything they come into contact with." He frankly admits that the attachment is a "prodding device," and declares it will prevent snoring "by prodding the wearer in the event of lying on the back."

The combined brace and prodder could be used by day, as well as by night.

"The prodding device could be worn with the brace at all times," the inventor explains, "and would serve to remind the wearer to straighten up in case of a tendency to lean forward, thus preventing too great dependence upon the brace itself for support." On this point there seems to be no room for argument.

In addition to these many advantages, this appliance might have another use, on which a tip is offered to the inventor free of charge. In the privacy of his home, if the metal projections were a little longer than indicated in the patent application, the wearer might use the prodding device as a hat rack and clothes hanger when he is not in bed.

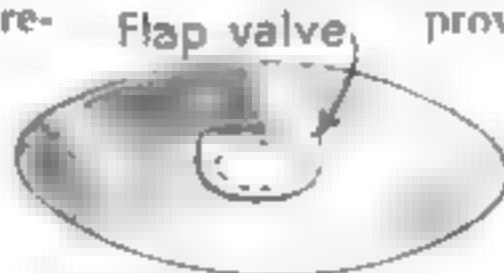
A California man has invented what may be called the anti-snoring shield de luxe. It is illustrated at the top of this page. Adequately to set forth its many special features, extra attachments and added attractions would be no mean job for a circus press agent. It seems doubtful, however, whether anybody except an engineer ever could learn to wear the thing successfully, because of the complicated valve system by which it filters the snores out of slumber—or graduates them to suit the ear in the event that limited special privileges



Here is a real masterpiece. The device, turned one way, will completely silence the snorer. Reversed, it allows him a little musical leeway

are accorded to the wearer by his victims.

Despite this, the inventor, with the inconsistency common to genius, contends that "the object of the invention is to improve, simplify and cheapen the construction of the device by providing the flexible mouth-



Through this one-way valve the snorer exhales through the mouth if he wishes, but there mouth-breathing option ends

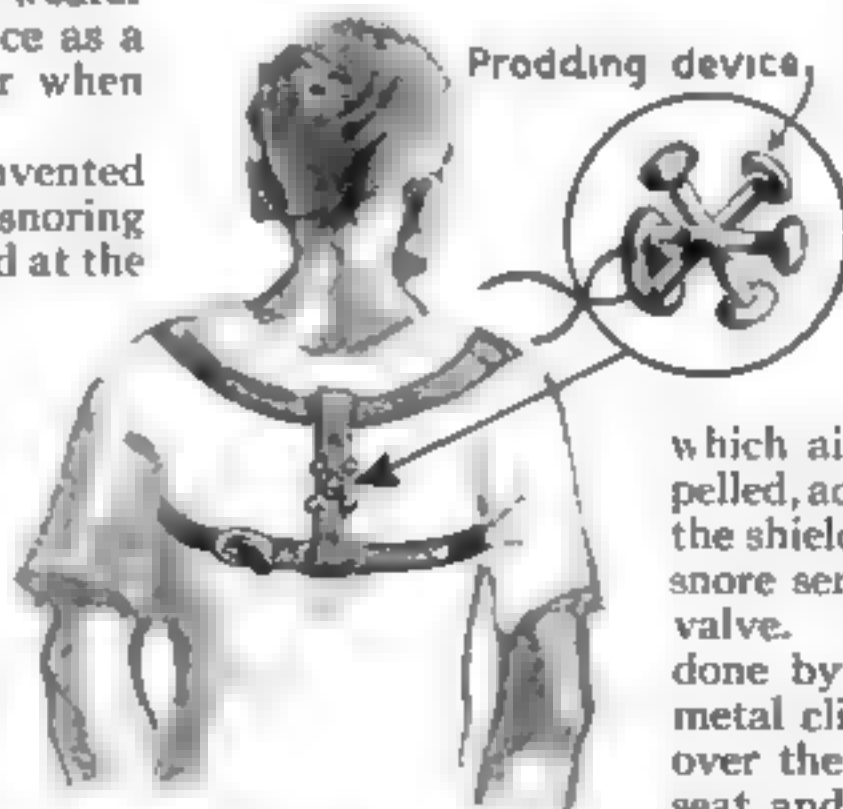
piece with a plurality of valves for controlling the volume of air expelled from the lungs through the mouth and for controlling the admission of air through the opening in said mouthpiece when the latter is reversed."

A technical description of the device is beyond the power of the writer. It

seems, though, that the inventor has tried to put a new interest into life for the snorer by adding to the valve scheme a means of regulating the size of the opening through

which air is inhaled or expelled, according to whether the shield is being used as a snore sentry or as a safety valve. The regulating is done by means of a little metal clip which is slipped over the edge of the valve seat and raised or lowered like the floodgate of a dam.

We assume that instructions as to how to operate the mechanism will be given with each device sold



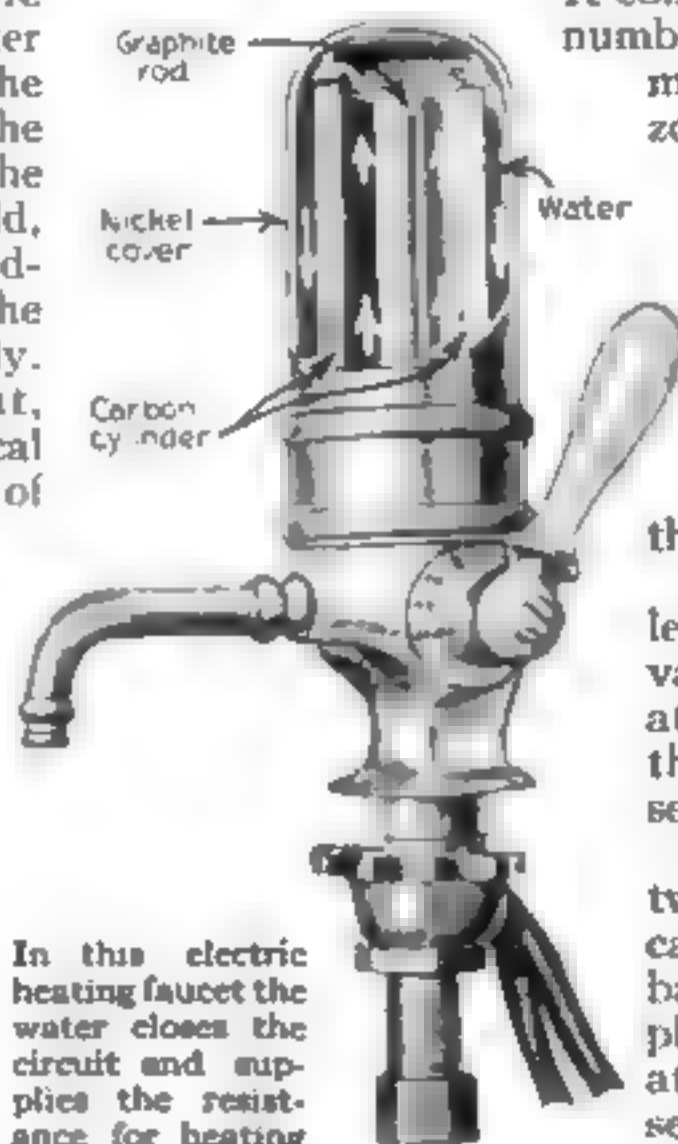
The man who devised this apparatus has probably suffered many things in Pullman sleepers or elsewhere. He has not the least compassion on anybody who snores

This Electric Heating Faucet Has No Switch or Coils

AN electric water-heating faucet, just placed on the market in California, differs from other devices of this kind in having neither electric switch nor coils, the water itself serving to close the circuit and to supply the resistance for heating. The device is so made that cold, warm or hot water, depending on the position of the handle, is supplied instantly.

The heating element, housed in the cylindrical casing that forms the top of the device, consists of an upright hollow carbon cylinder enclosing a space in which is a graphite rod. These parts are insulated from the remainder of the device, and each is connected by an insulated wire with one pole of an ordinary lighting circuit. When the handle is turned to the "cold" position, the water flows through a by-pass without entering the heating element. When it is turned to the "warm" position, the by-pass is closed and the water passes upward between the cylinder and post, overflows at the top and passes downward in the space between the cylinder and cover. The circuit is closed by the water, thus doing away with the necessity for a switch, since no current can flow unless the heating element of the faucet is filled with water.

When hot water is wanted, the handle is turned to such a position that only a small flow of water is admitted — just enough to allow it to be thoroughly heated before it reaches the outlet.

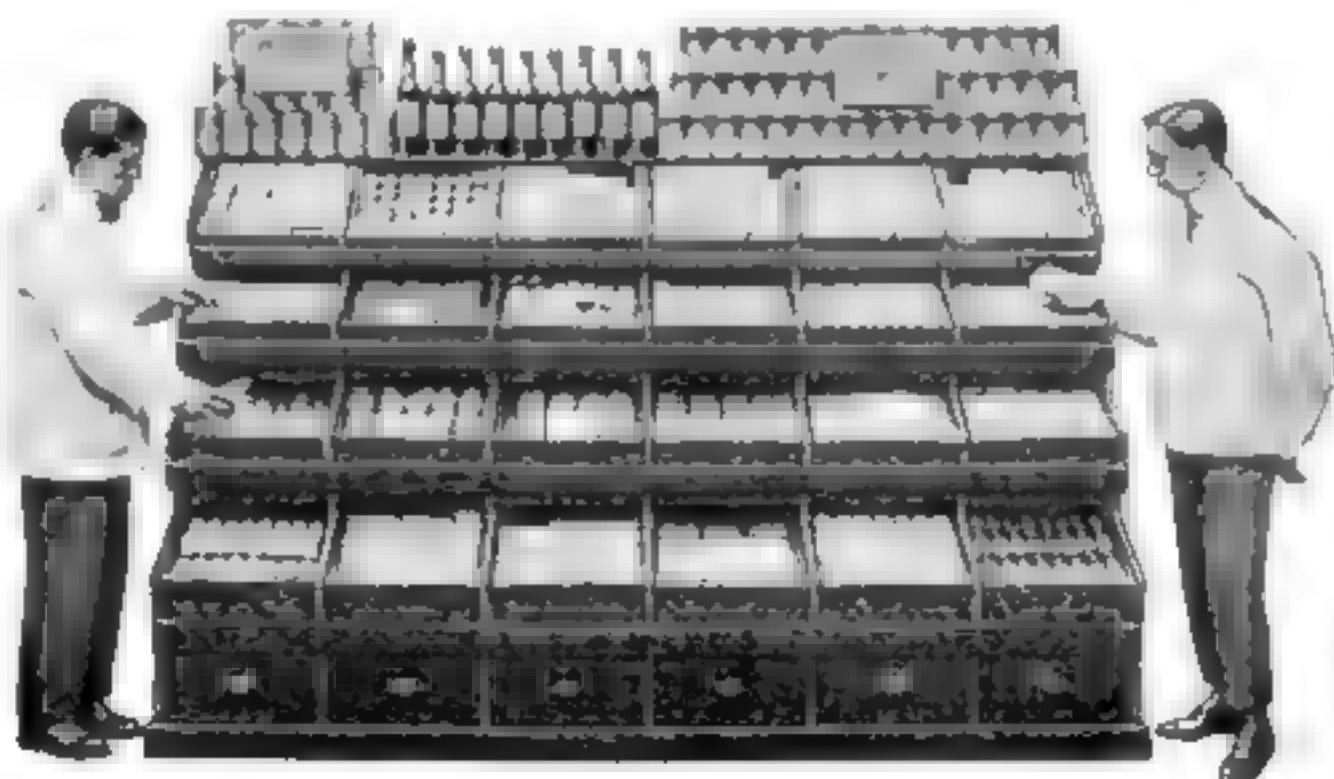


A Space-Saving Display Fixture Which Also Saves Clerk Hire

THE display fixture shown in the photograph below will prove a money-saver as well as a convenience to the shop-keeper. It consists of a framework having a number of inclined drawers which may be drawn forward to horizontal position or sloped backward and up, so as to display every article to the passerby. The drawers may be provided with hinged glass covers or left open as desired. When covered, they are opened by simply raising and sliding forward the front part of the drawer.

Customers may examine at leisure all the articles in the various drawers without special attention from the clerk, so that one clerk may attend to several customers at a time.

As the framework stands on a twenty-seven-inch base, two cases can be placed back to back so that articles can be displayed to customers in two aisles at the same time. One clerk can serve two cases. In the drawers underneath the frame, heavier articles or surplus supplies are kept. In this way every available inch of floor space can be utilized. Moreover, the clerk, having his stock plainly marked as to prices and always before him becomes thoroughly familiar with it in little time.



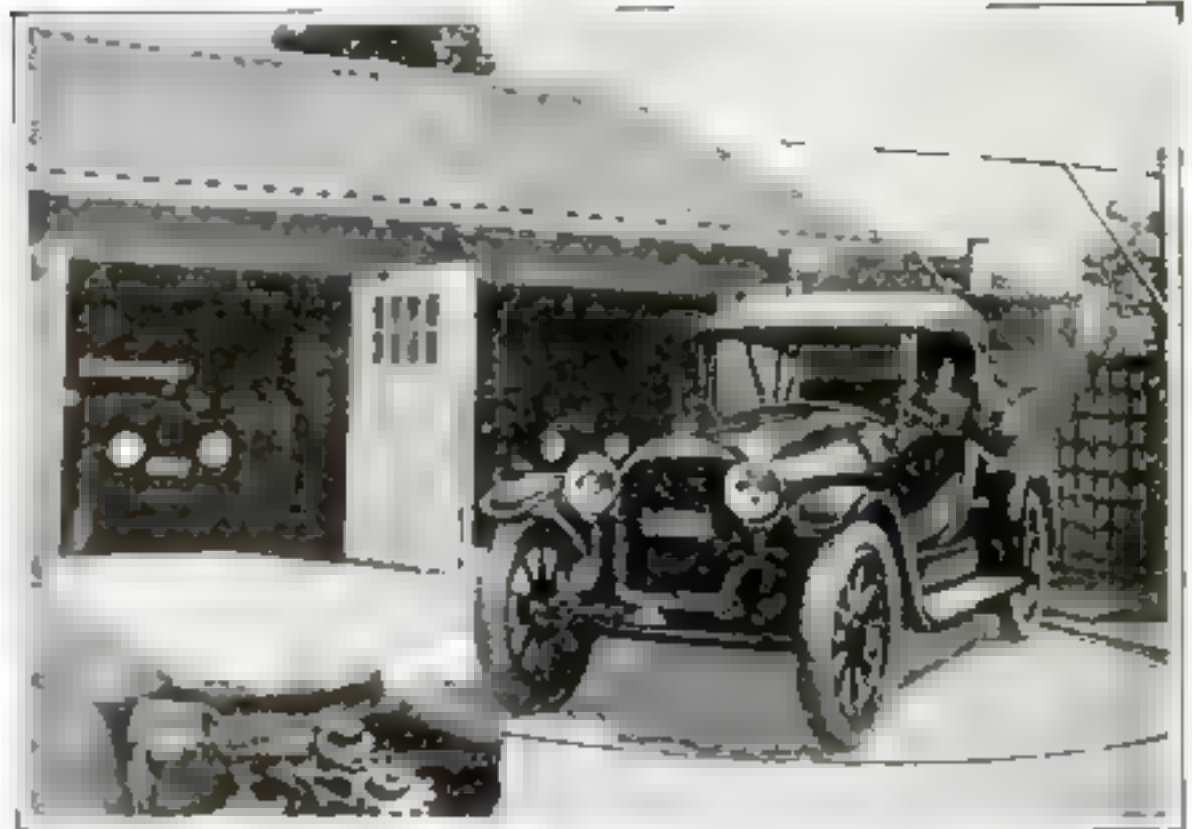
With prices plainly marked, the articles in this compact display case practically sell themselves. Surplus stock is kept in the drawers below

The Full Dinner Pail. It's Built Like a Fireless Cooker

A THERMOS bottle will keep your coffee hot, so why not the thermos pail to keep your entire dinner at the proper temperature, whether cold or hot? Byron Bruegger, of Wisconsin, thinks such a pail will be in so great a demand that he has taken out a patent on a design for one.

The bottom of an ordinary lunch pail has an extra wall in it, around the outside of which the air has been exhausted. In preparing for the day's picnic, the desserts, the butter and the other victuals that are to be kept cold are placed in the very lowest chamber. A rather shallow chamber from which the air has been practically removed is provided on top of this cold chamber, and into this "vacuum" chamber the meats, vegetables and the other hot dishes are placed. Over this chamber is a layer of asbestos. Then comes another hot food chamber. We have, therefore, a poor heat-conducting medium surrounding the hot and the cold chamber and separating the one from the other. Little heat can pass either in or out of the chambers and the cold dishes will stay cold and the hot ones will keep hot for a reasonable length of time.

Other dishes that are to remain at ordinary temperatures occupy the remainder of the pail. A neck is even provided on the cover of this pail to provide a place for a drinking cup. With such an arrangement an entire family on an outing could be supplied with a dinner complete from soup to ice cream and everything at the most desirable temperature.



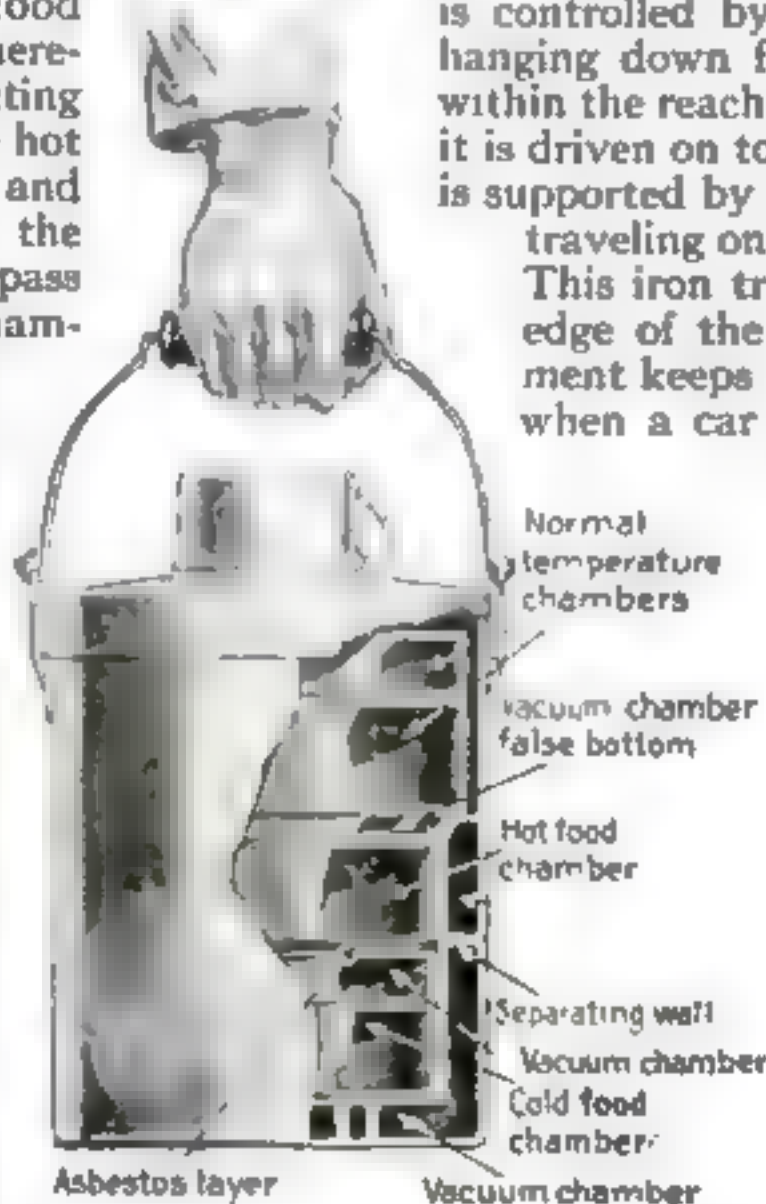
The turntable is 14 feet in diameter. The motor operating it is mounted in a pit at the edge of the turntable pit

Electrically Operated Turntables for Automobiles

A TURNTABLE that is operated by an electric motor, by means of a push button, is very valuable where the confines of the yard are so narrow that an automobile cannot be backed out without risk of sidwiping the house or fence. The motor is controlled by means of a push-button hanging down from an arm so that it is within the reach of the driver of a car when it is driven on to the turntable. The table is supported by wheels with roller bearings traveling on an iron track, within a pit. This iron track is placed out near the edge of the turntable. This arrangement keeps the turntable from tipping when a car is driven on or off of it.

The motor is connected with a sprocket wheel by means of worm drive. A sprocket chain driven by this sprocket wheel extends around an angle-iron ring which is secured to the underside of the table near the periphery. This worm drive keeps the turntable from skidding.

The advantages of such a device in a small private garage and even in public garages where space is usually at a premium, are numerous and obvious.



Everything from hot soup to ice cream can be put into this picnic dinner pail

An Accommodating Gas Stove. It Boils the Coffee and Then Wakes You

A GAS stove which arises at dawn, boils the coffee and wakes you up when it is ready, has been invented by Gemaro Rosa, of Brooklyn, New York.

In order to describe the workings of this accommodating stove it would be necessary to use at least fifteen diagrams and seventeen pages of this magazine crammed with text.

For our busy readers we have boiled Gemaro's invention down to its essentials. It is an ordinary gas stove having a pilot-light to which is attached a clock mechanism. A dial over the clock-works serves to tell the time. A smaller dial is used to set the alarm, igniting and extinguishing devices.

When properly set, the burner under the coffee pot will automatically ignite at a pre-determined hour and boil the coffee for four or five minutes. The flame will then lower of its own accord for slow boiling for another five minutes, after which it will shut itself off entirely. The coffee is now ready for you and if you are not aware of it the trusty alarm will notify you of the fact.

There is no possibility of the coffee boiling over unless you disregard the alarm and go to sleep again.



The burner under the coffee pot will light automatically at a pre-determined hour

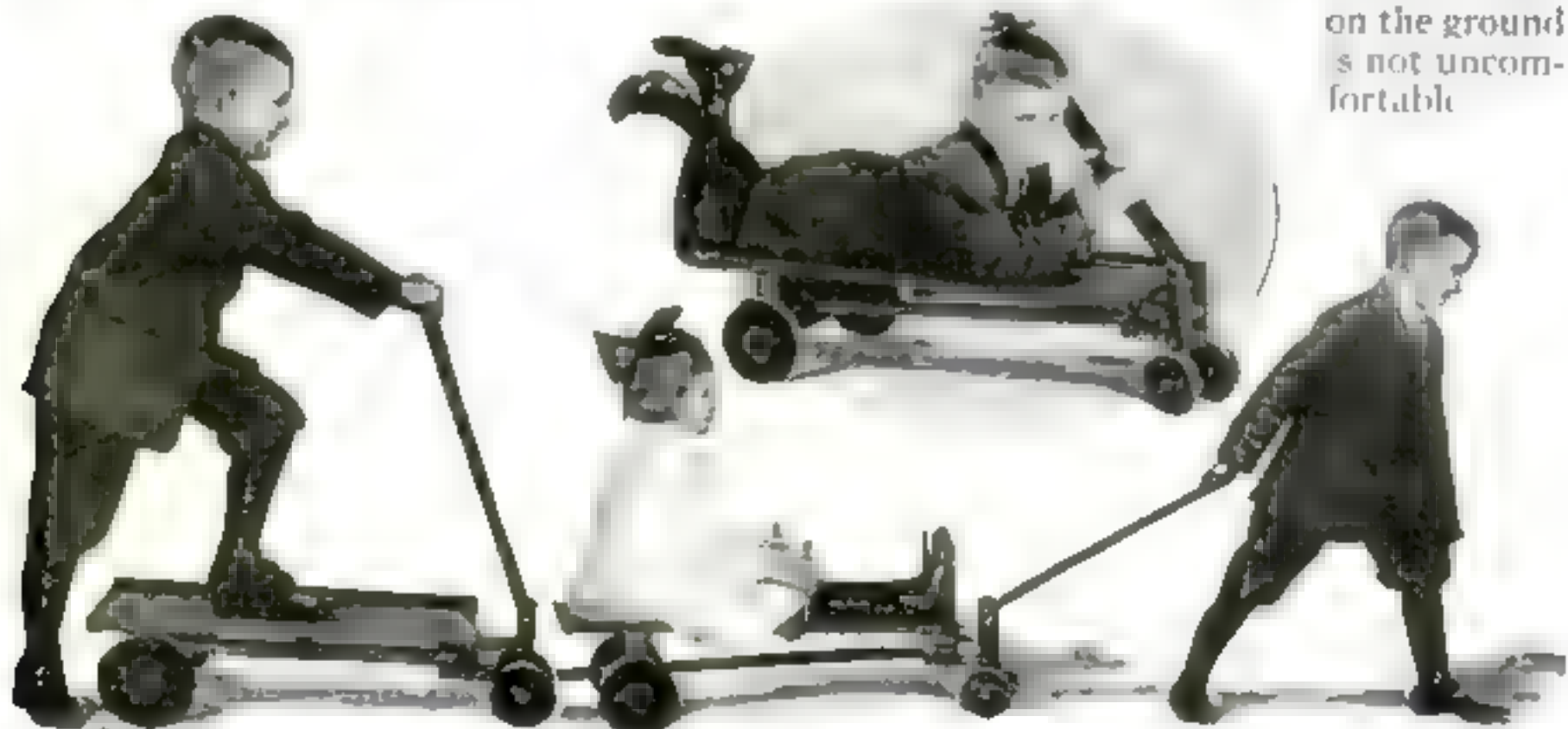
An Electric Wire in the Street Ignites a Balloon

A PECULIAR accident occurred recently when six students training for aviation work attempted to land a balloon in East St. Louis. The gas-bag came into contact with a high tension wire and immediately burst into flames. Luckily the basket was brushing the ground at the time. All the students were able to leap out of the basket unharmed. Prompt action in putting in a fire alarm brought fire fighters in time to prevent the basket from being burned.

The American Boy's Wagon. It Is Equal to Any Emergency

THE ordinary American boy makes strong demands on his wagon. The one shown in the illustration is equal to any emergency. It can be a common freight carrier when necessary, or a passenger car in which lady friends may be given a ride, occasionally. But first of all it is a coaster and scooter, with a first-class steering rod and wooden wheels which never get out of order. It is close to the ground so that when it is used merely as a scooter the position with one foot on the floor-boards

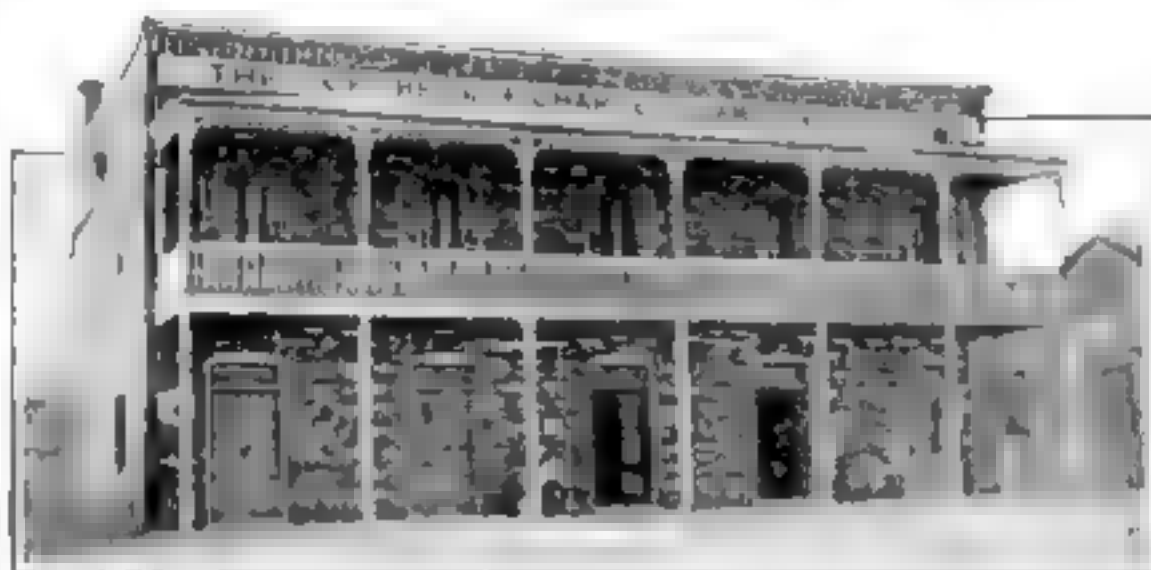
and the other on the ground is not uncomfortable



A strongly built combination wagon which is equal to any emergency in which a wagon, coaster or scooter can figure. Here we have three of the most important uses illustrated

This Store Sets a New Style in Exterior Decoration

ON the front of the only store at Point Isabel, Texas, on the Gulf Coast, a local artist has painted in their natural colors a representation of some of the fish that he has seen caught in the Gulf near by. Most of these are well-known varieties, but there are some strange ones, as for example the large monster to the left of one door. This animal, of which the name is unknown, was washed ashore some years ago in a storm.



Hand-painted representations of different kinds of fish caught in the Gulf Stream off the coast near by decorate this store front

canoes. Volcanoes are necessarily exempt.

It is possible to collect this sulphurous gas and make sulphuric acid out of it, but some plants are so located that transportation costs forbid. Sulphur, on the other hand, may be stored out of doors as long as desired and sold whenever there is a good price available for it.

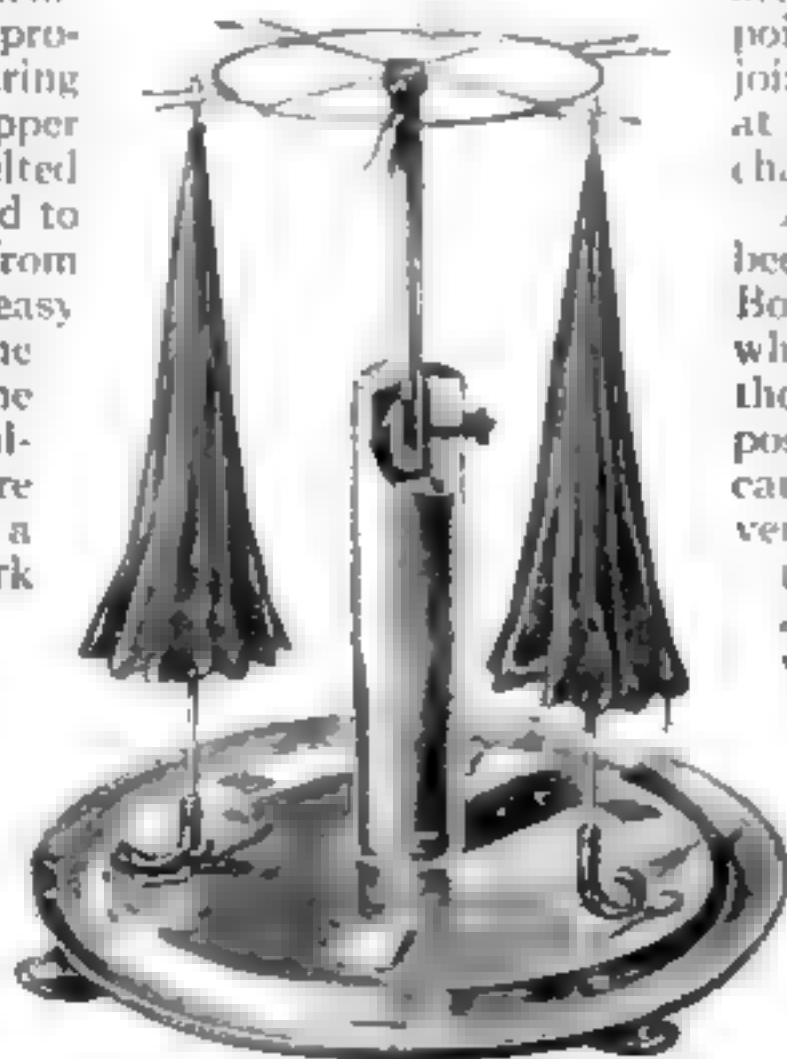
Two methods are known, a wet one and a dry one, but both depend primarily upon the French leave which sulphur invariably takes of its oxygen content in the presence of certain other bodies.
—ELLWOOD HENDRICK.

Getting Sulphur Without Liberating the Fumes

IN regard to getting the sulphur fumes out of smelter gas, Professor S. W. Young, of the Leland Stanford University, lately presented to the American Institute of Chemical Engineers a paper on proposed methods of procuring crude sulphur. When copper and other ores are smelted they must also be roasted to get the sulphur away from the metal. This is easy enough to do, but the fumes that escape into the air are the fumes of sulphurous acid, and if there is anything that disposes a farmer to carry a pitchfork and a double-barrel shotgun along with him when he goes to make his protest, it is the stifling smell of these very sulphurous fumes in the air. In fact in some states the laws now forbid the liberation of the gases of burning sulphur in nearly every activity except that of vol-

What to Do With That Dripping Umbrella When You Come in out of the Rain

IN order to properly dry out an umbrella it should be suspended by its tip so that the water will drain off toward the handle. This prevents the accumulation of water at the point where the ribs are joined, which results in rust at that point—and the purchase of a new umbrella.



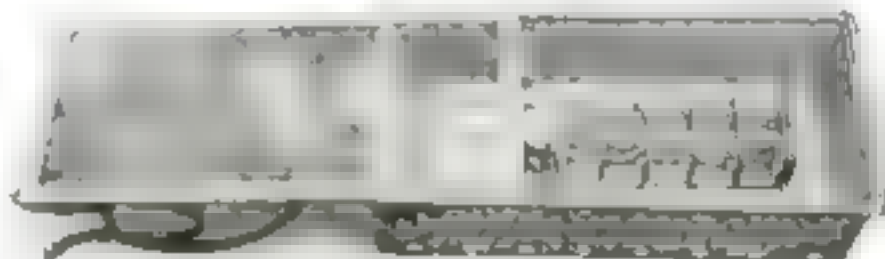
The umbrella-holder suspends the umbrella, handle-downward, so that the water drains off into a pan beneath

An umbrella-holder has been patented by Hermania Bocker, of Buffalo, N. Y., which is designed to suspend the umbrella in the correct position for drying without causing unnecessary inconvenience. The tip of the umbrella is held in a clasp arranged at the top of a vertical bar. This clasp is adjustable in height so that umbrellas of different lengths may be accommodated. A drip-pan is arranged beneath. Into this the water runs and is held until the pan is emptied. Rubber blocks are shoved under the umbrella handles.



After the envelopes are cut, folded and gummed they are passed over a conveyor to the packing boxes

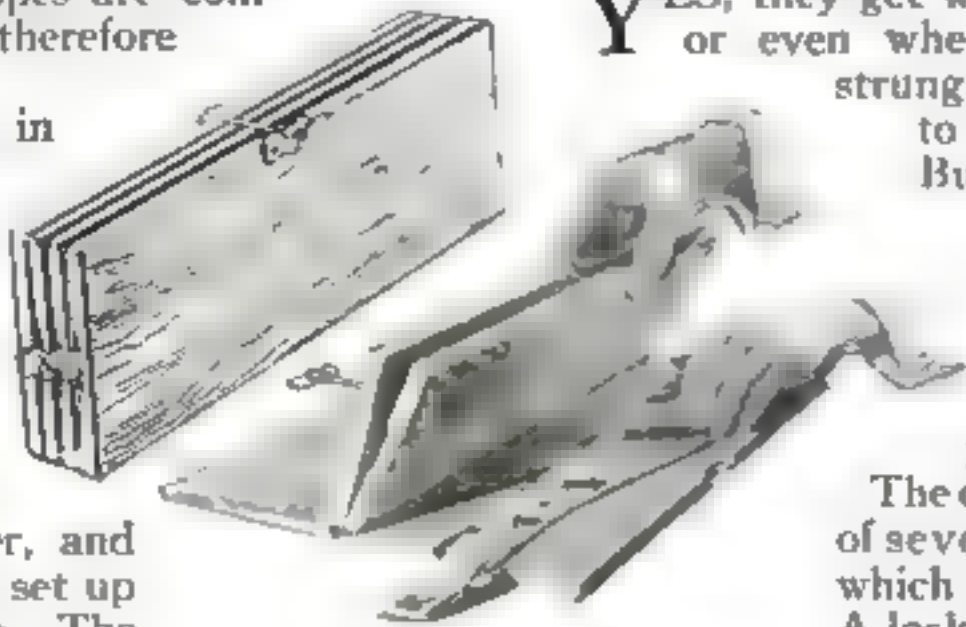
The electric heater which dries the glue when the weather is damp



Using an Electric Heater to Dry the Glue on Envelopes

ENVELOPE making today is an exceptionally rapid process in which a single machine neatly cuts the paper stock, folds and glues the envelopes, and then carries these on a conveyor to the boxes waiting for them. In dry weather this process goes on uninterrupted; the glue dries in the time it takes the machine to fold the envelope flaps back. In rainy weather, however, the process does not go on so smoothly. The glue does not dry quickly enough and hundreds of new envelopes are completely sealed and therefore wasted.

A manufacturer in Chicago, Ill., places a simple electric heater under the conveyors of his machines. On very damp days a heavy current is sent through the resistances of the heater, and the hot air currents set up quickly dry the glue. The strength of the current depends upon the dampness.



The combination necktie presser and case. It is like a four-leaved book

How to Store Flour to Prevent It from Molding

SPECIALISTS in the United States Department of Agriculture have studied the best means of storing flour in the home so that it will not be contaminated by odors or become musty. Flour should never be stored in the cellar even though a bin has been built in the cellar for that purpose. A cellar is usually damp and odors are generally found there which the flour will absorb. The attic is as bad a place to store flour as the cellar. In the summer the temperature of the attic is too high and as the ventilation is usually poor the flour is likely to acquire a musty odor. Ex-

cept in very small quantities flour should not be stored in the pantry or kitchen because the temperature is too uneven and there are too many odors which the flour is likely to ac-

quire. Every house should possess a small, well ventilated store room where non-odorous food should be kept. The temperature in this room should be so regulated that it will not fluctuate more than a very few degrees. Always clean the flour container before putting in new stock. If flour is kept in the barrel in which it was purchased, boards should be placed under it to keep it off the floor.

One of the Newest Wrinkles for Keeping Your Neckties Smooth

YES, they get wrinkled in a drawer, or even when hung on a cord strung from the chignonier to the electric light. But here's a solution.

A Florida inventor now is marketing a combined case and presser for men's ties that is proving satisfactory.

The device consists simply of several leaves, between which the ties are placed. A locking mechanism gives any degree of pressing tension desired.

Fastening Motors to Ceilings Without Scaffolding or Tackle

IT is hard to attach motors to ceilings or overhead beams in factory rooms. Here is a mechanism or device which is said to do this with great ease. It is a portable elevator or tiering machine, and it is employed to elevate and hold the motor in position until it is fastened to the ceiling, thus eliminating scaffolding, tackle and hoisting arrangements. Four to six motors can be installed in the time formerly required for the mounting of one. Of course the machine can also be used for inspecting the motors, for taking them down to be repaired, for renewing pulleys, and for putting up shafting.

The machine itself consists essentially of an elevating platform with two uprights or guides and a revolving base with a ball-bearing center on which it swings like a turntable. The whole unit is mounted on a wheeled truck equipped with a floor lock. It was primarily designed for the piling or tiering of bales, cases, barrels, etc., in storerooms and warehouses, thus enabling the entire space up to the ceiling to be utilized. Two sets of elevating gears are provided.

Looping the Loop in a Rocking Chair —for Exercise and Diversion

GLANCE at this rocking chair. Imagine yourself resting in it, strapped in, too, around chest and loins. It seems restful enough. But why the straps? Just for safety, friend. For this chair aspires to demonstrate perpetual motion, once it gets started. As you rock, it gathers momentum until finally—hold your breath—it turns you over and over and over like a cart-wheel.

The skeleton framework of the chair is composed of two vertical, parallel elliptical hoops fastened together by a number of horizontal tie-bars. To these tie-bars the seat and back of the chair are attached, and also the straps which hold you while you are cart-wheeling. A bar at about shoulder-height acts as a hand-grasp.

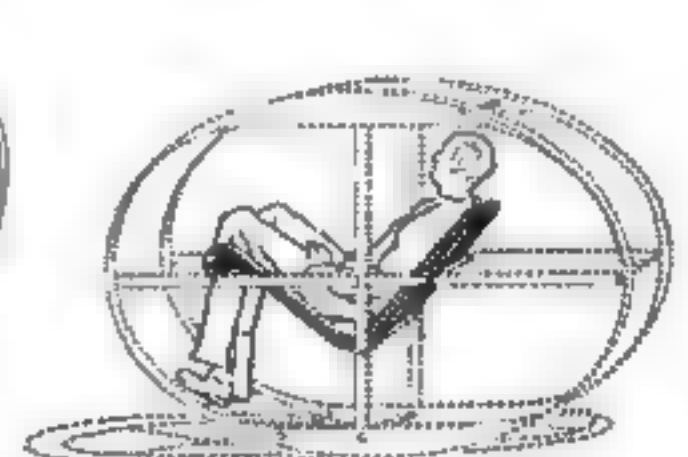
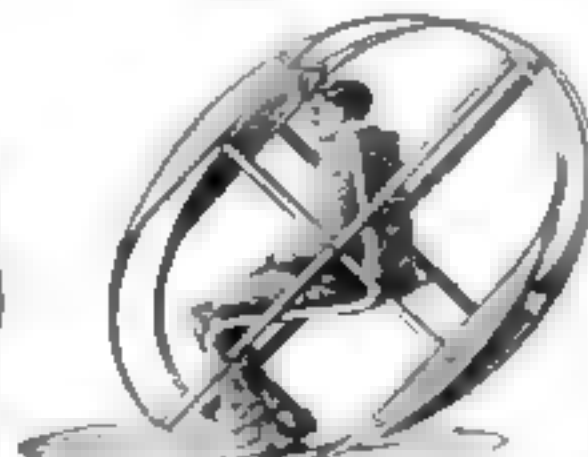
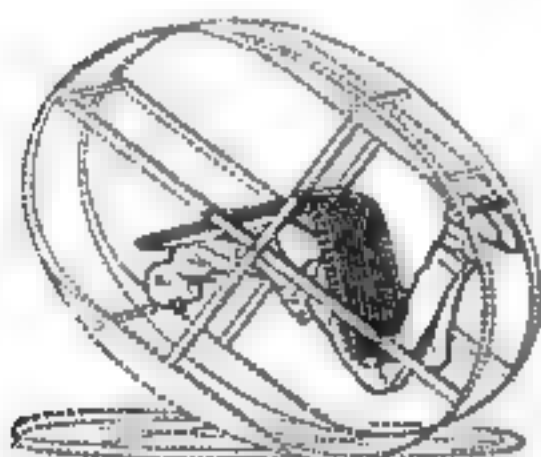
You seat yourself in the chair, strap yourself in, grasp the hand-bar and give yourself a swing in the usual manner. You start off gently enough, but your progress depends upon your own physical exertion.

Before you become seasick, it is best to reverse the direction of the motion and thus bring the chair to its normal position, letting it gradually subside.



The Portable Elevator or Tiering Machine

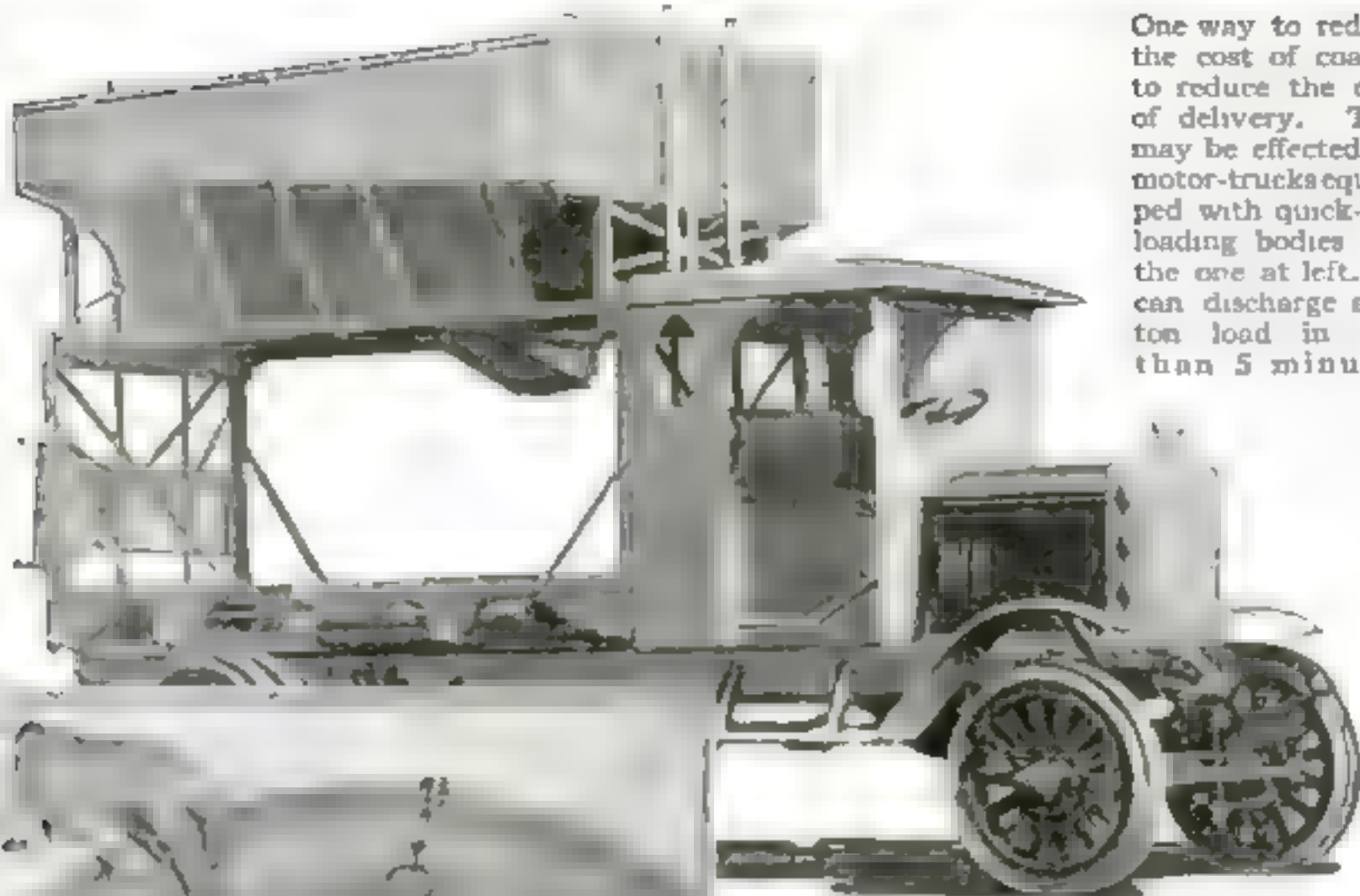
The machine was primarily designed for piling bales, cases, barrels, etc., in warehouses, so that space up to the ceiling could be utilized. Two sets of elevating gears are provided, one operating at high speed and handling loads up to 800 pounds, and the other at a lower rate of speed for handling from 800 to 1,800 pounds. It will elevate loads from six to twenty feet. The frame is hinged so that the top section can be folded over to facilitate the passage of the machine through doorways.



You sit in this chair, strap yourself in, grasp the handle-bar and start rocking, turning cart-wheels, if you like and as long as you like. To bring the chair to a stop you reverse the motion.

New Duties and Efficiency Devices for

One way to reduce the cost of coal is to reduce the cost of delivery. This may be effected by motor-trucks equipped with quick-unloading bodies like the one at left. It can discharge a 5-ton load in less than 5 minutes



Steam vaporizer attachment for cylinders to increase power



Unit tire chains attached to a wheel by a bracket or strip of metal fastened to the rim with projecting hooked-over ends to receive the rings on the ends of the chains

A power-driven valve seat grinder attached to a bench with special holding devices for Ford engines

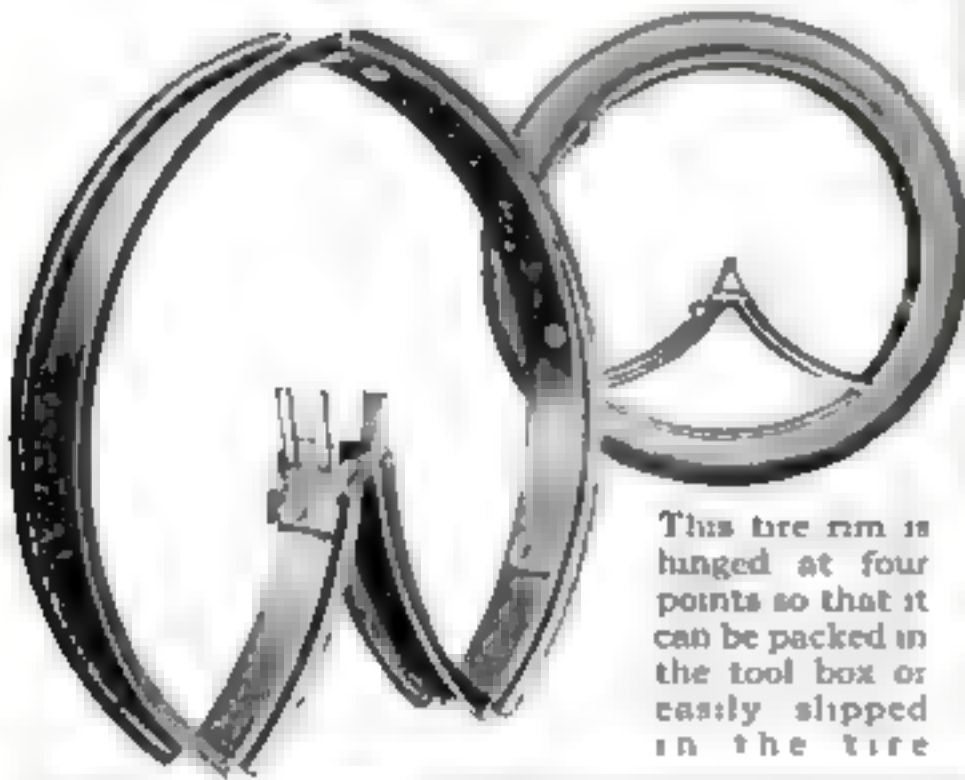
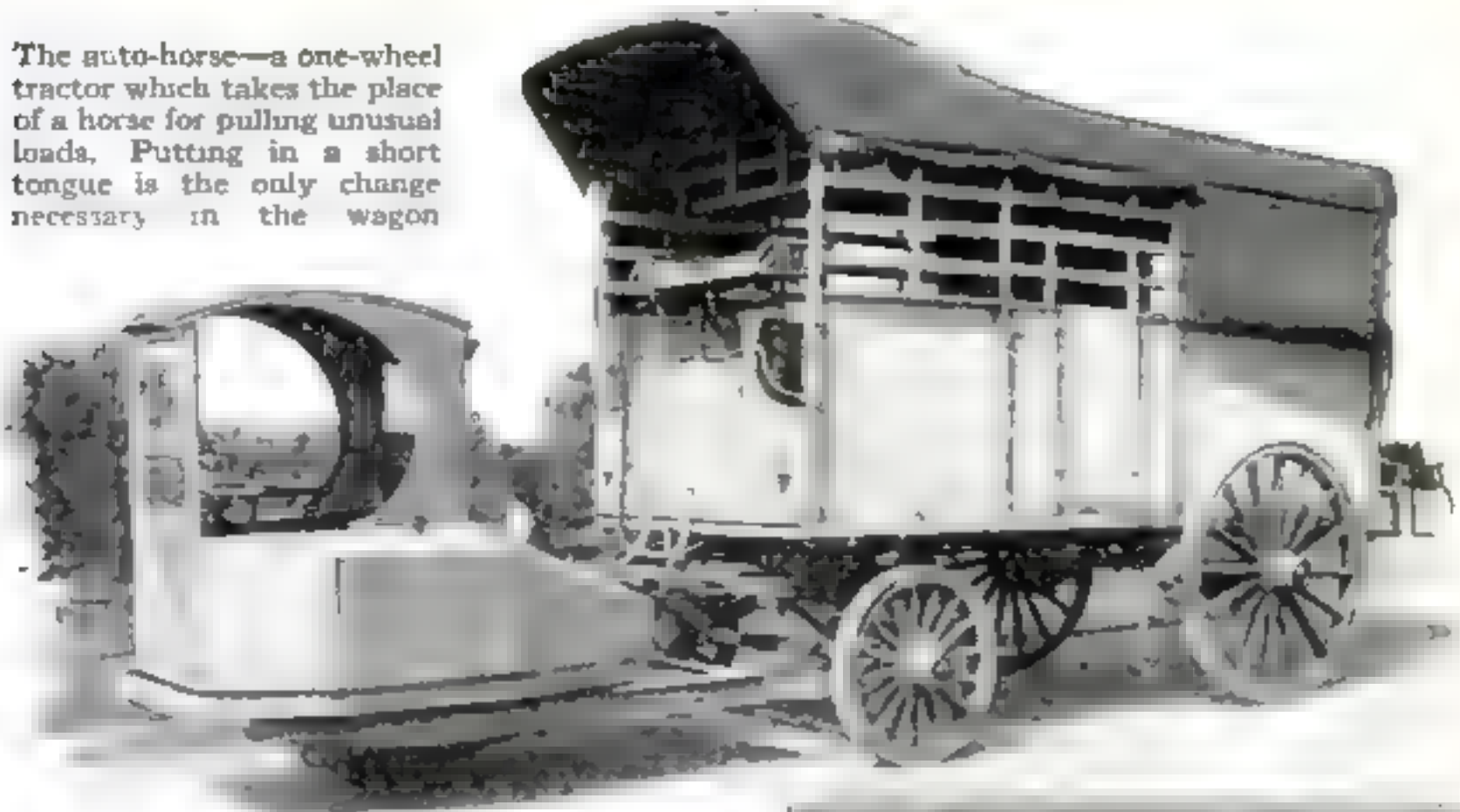


A new use for the old fashioned side-saddle. It takes the place of the rear seat on a motorcycle

Here the automobile is drawing an entire kitchen, although on a diminutive scale. It carries hot coffee and soup to the fighters and travels night and day

the Up-to-the-Minute Motor-Vehicles

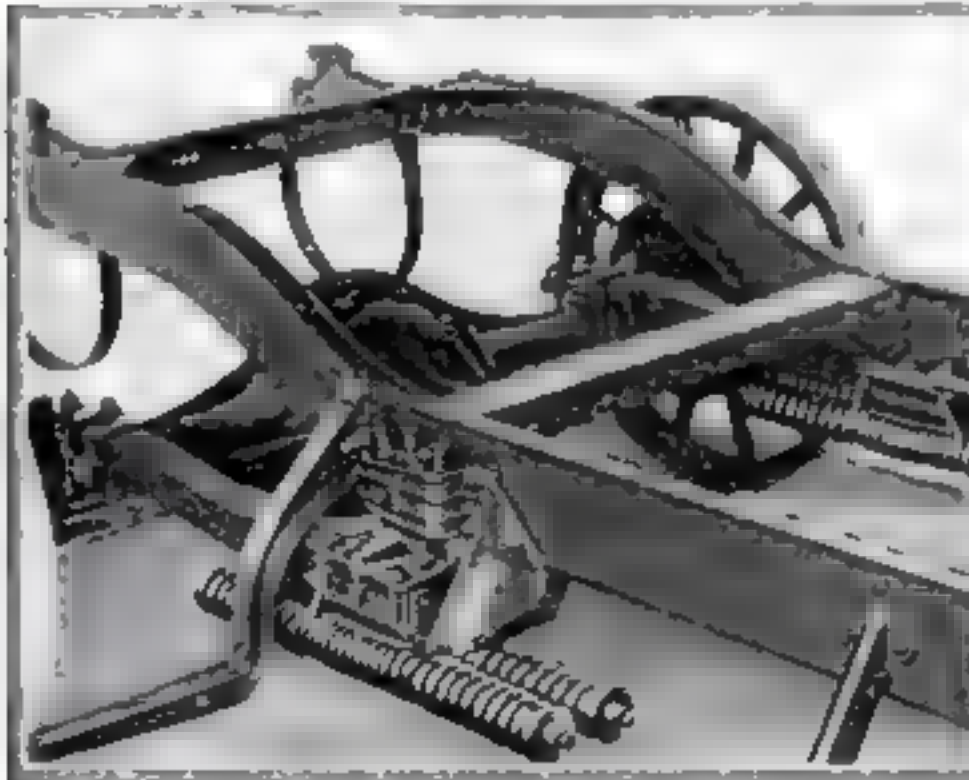
The auto-horse—a one-wheel tractor which takes the place of a horse for pulling unusual loads. Putting in a short tongue is the only change necessary in the wagon



This tire rim is hinged at four points so that it can be packed in the tool box or easily slipped in the tire



A piece of metal curved like a tile shovel is gradually slipped under the tire of a mired wheel to lift it out

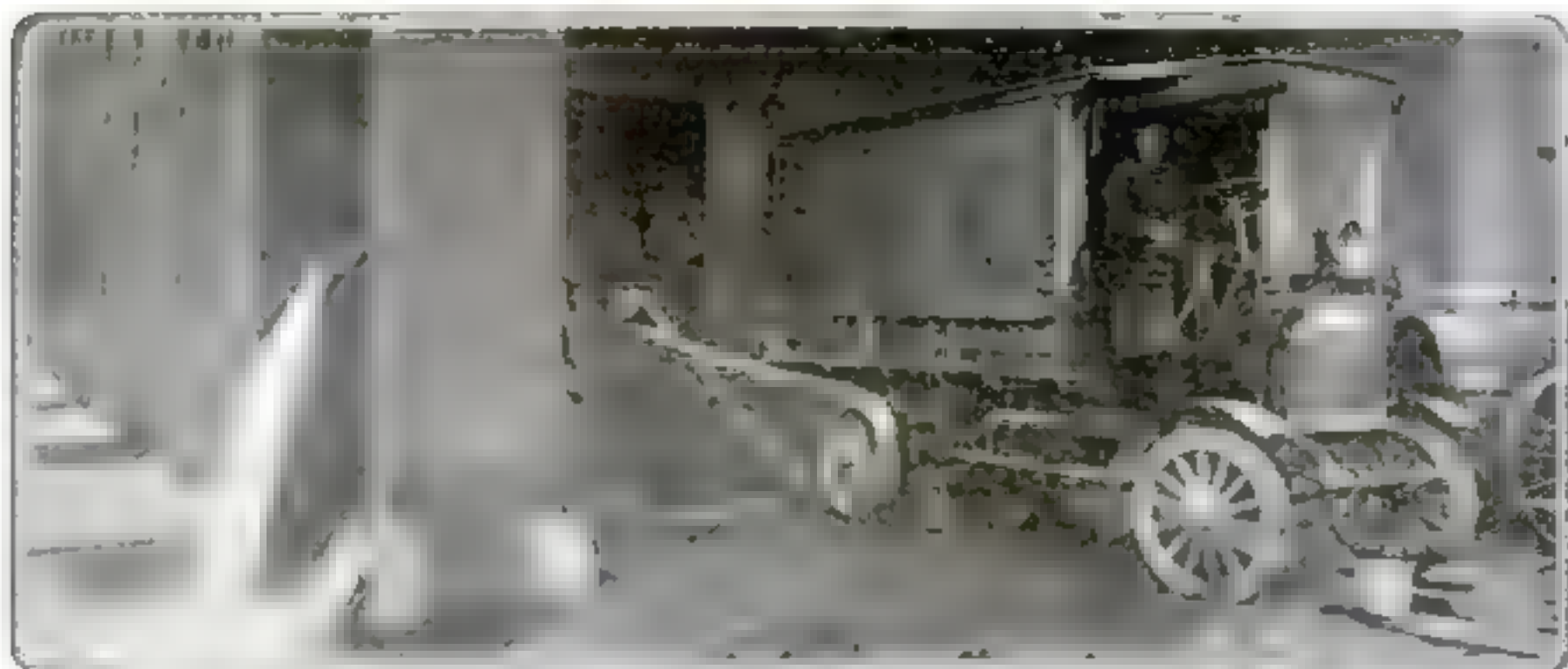


A new type of coil spring in horizontal position under the automobile frame takes up shocks



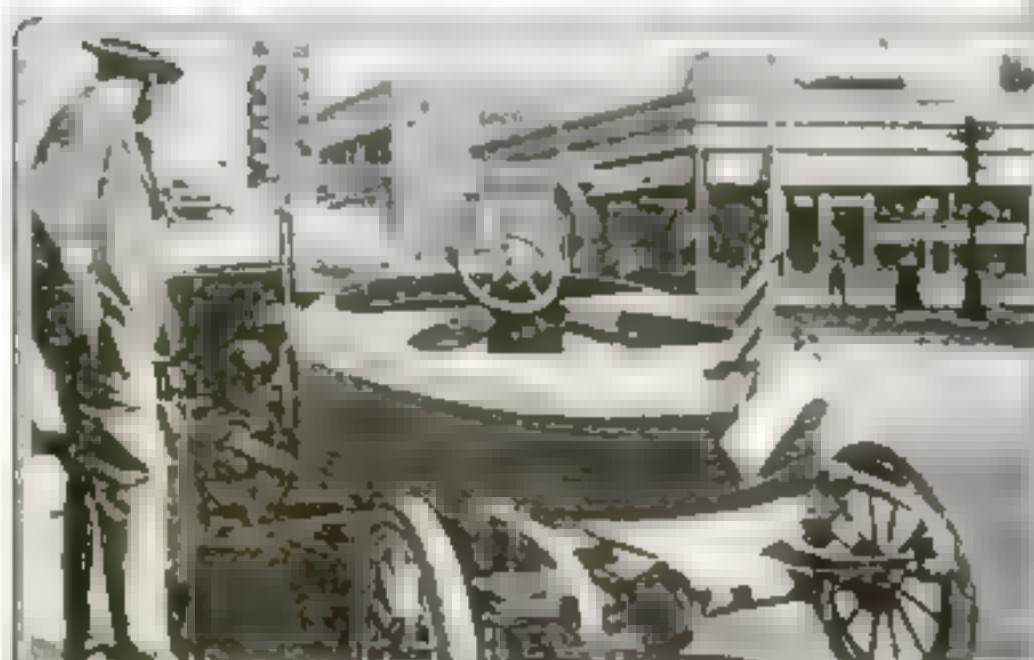
A narrow strip of cement walk is appreciated when the ground is muddy

"Versatility" Is the Watchword Among the



A truck, with one rear wheel picked up and belted to a centrifugal pump, furnished enough power to pump out a flooded basement

Below: A freak car body designed on the lines of a very speedy motor-boat



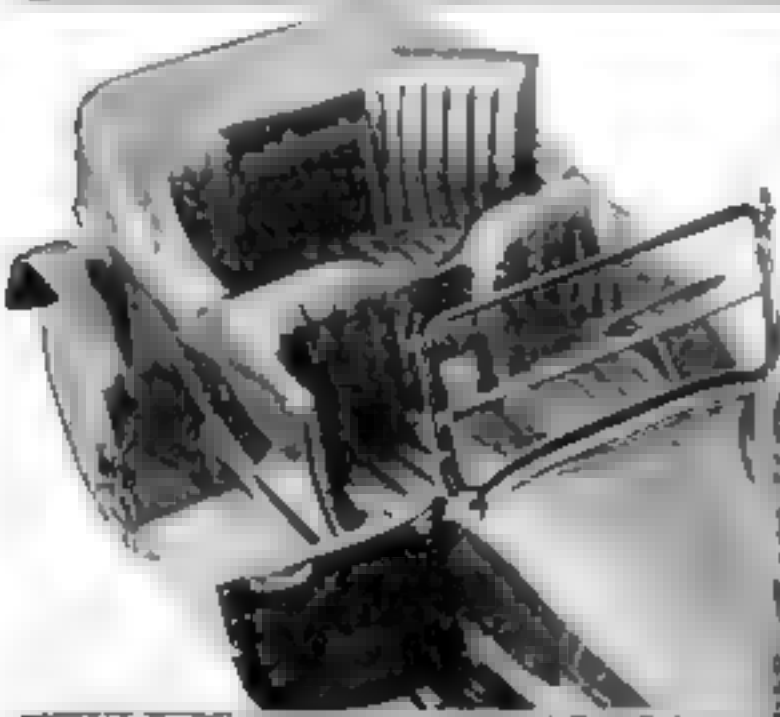
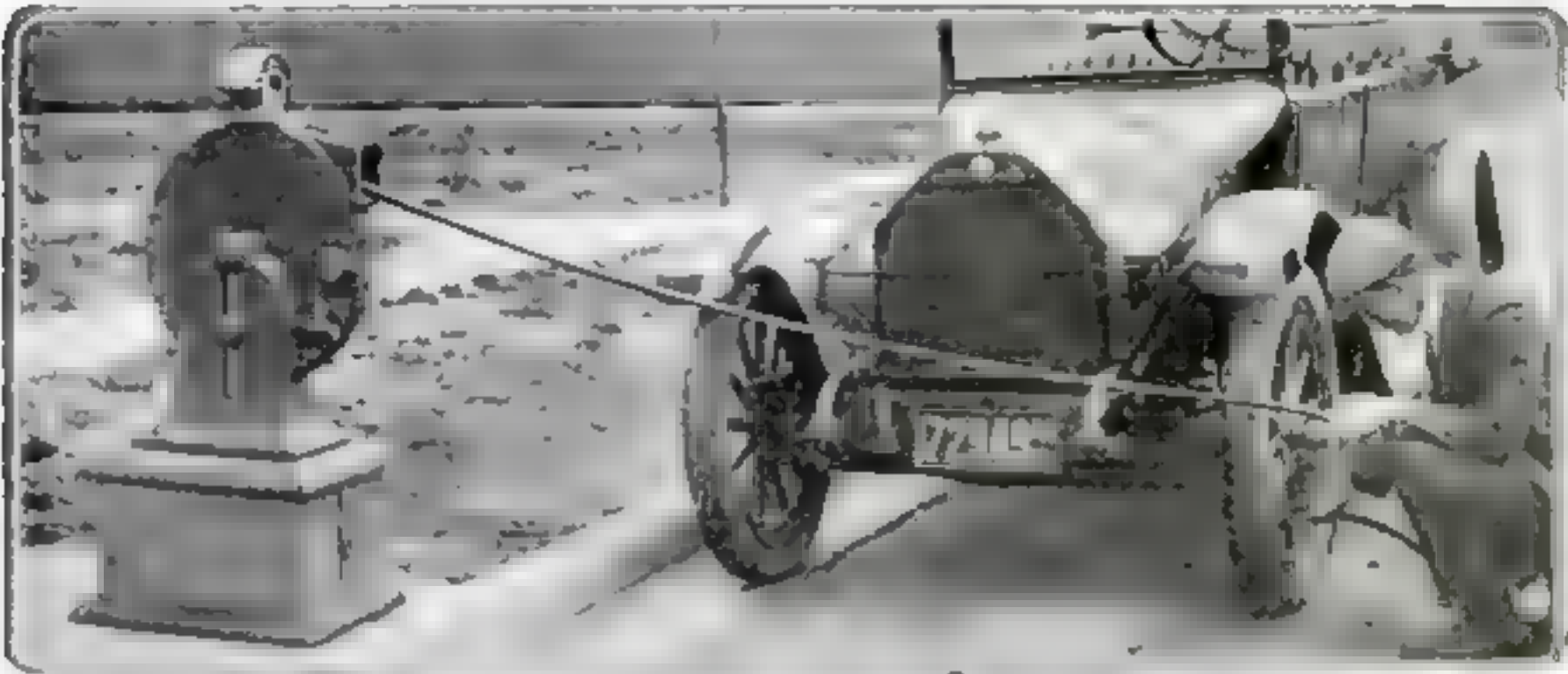
A lock that releases the steering wheel so that the wheel spins like a top



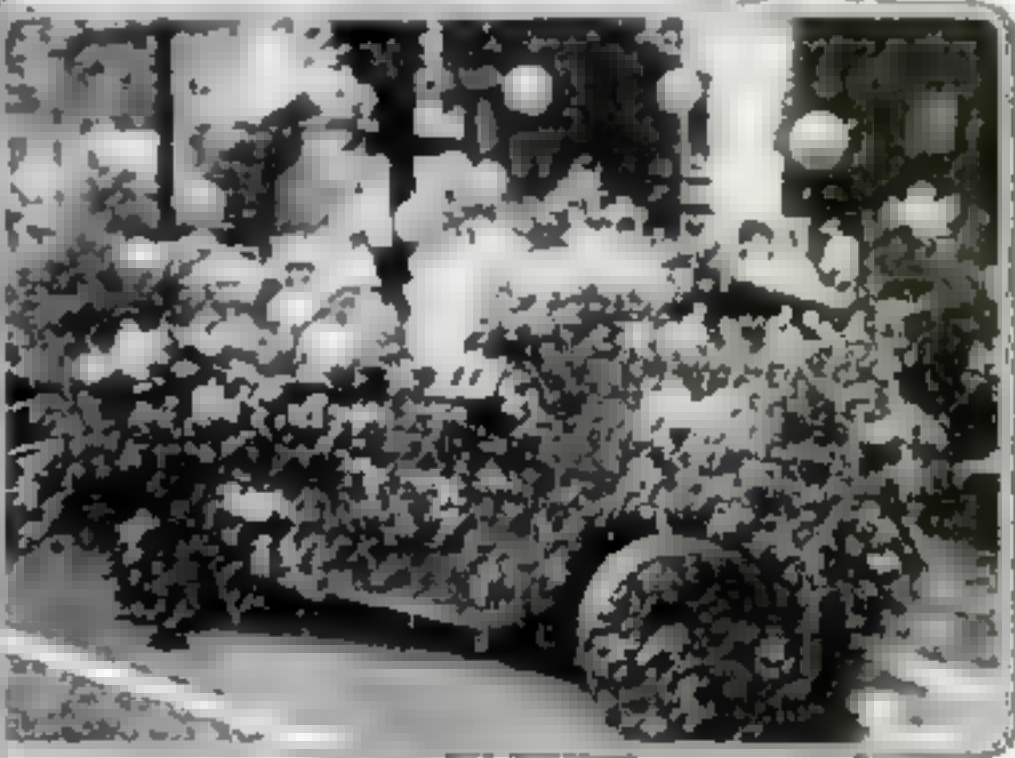
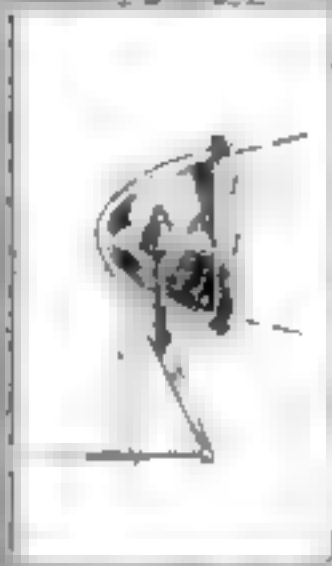
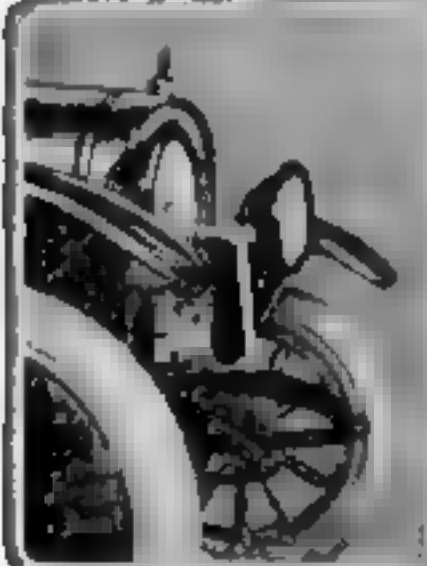
An auxiliary cooling system placed in the false door of a Ford car. It takes care of steam generated by the radiator

At left: A canteen that fits on the running board of the car is useful for cross-country trips

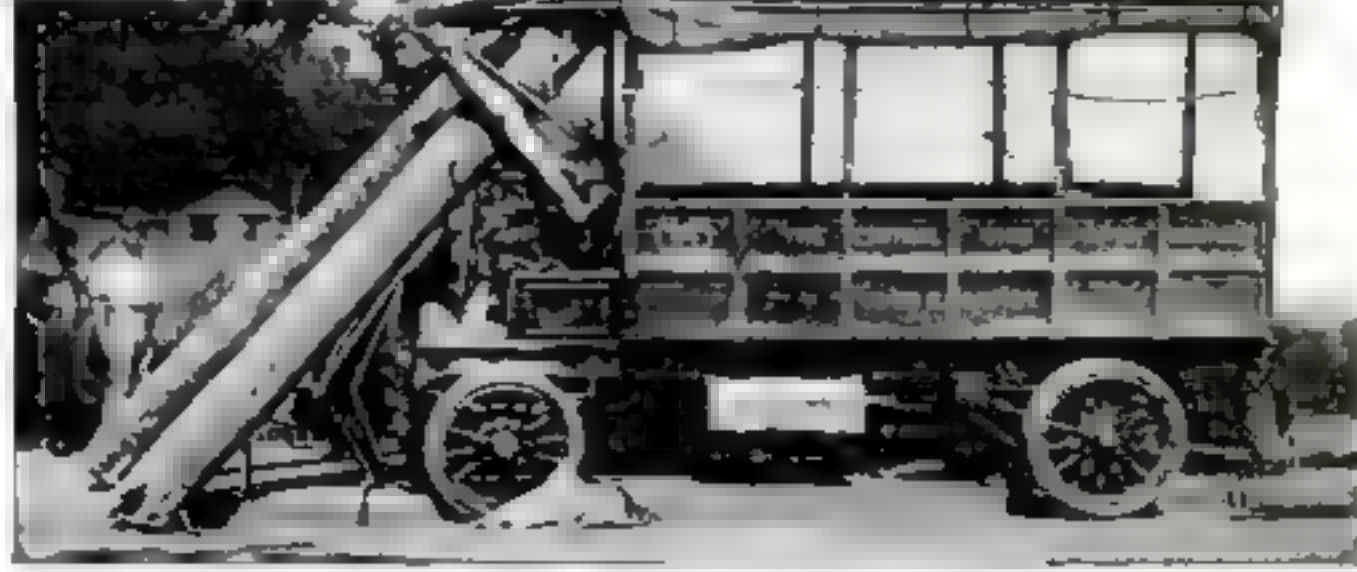
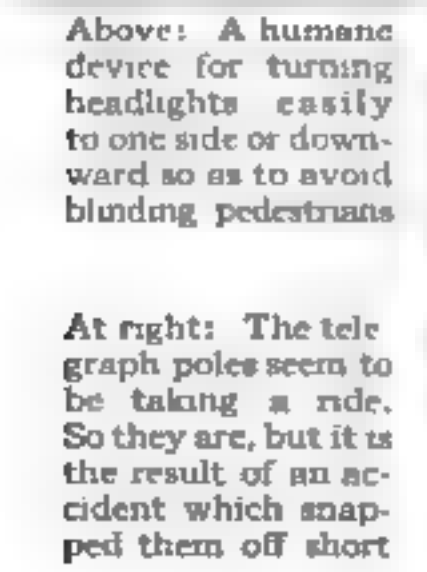
Manufacturers and Owners of Automobiles



At left In this new type of body, the rear seat is removed to obtain access to a storage compartment concealed behind it



One wheel peeping through reveals the fact that this is an automobile in carnival dress



Rivers That Flow in Two Different Directions

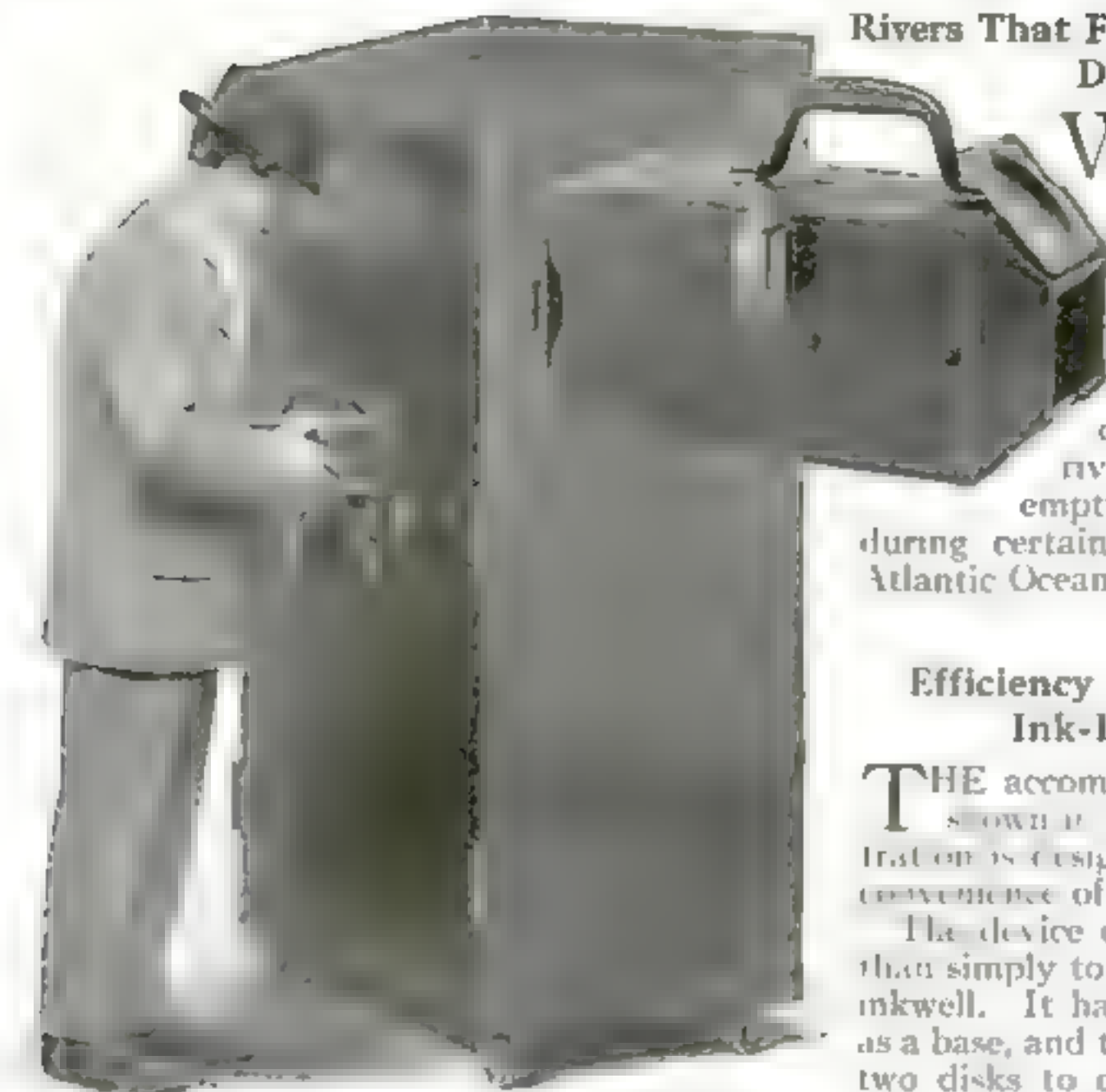
WHILE making measurements of river flow in the upper Mississippi River basins and in the Hudson Bay recently, the United States Geological Survey discovered that some of the rivers under investigation empty into the Arctic Ocean during certain seasons and into the Atlantic Ocean at other times.

Efficiency as Applied to an Ink-Bottle Holder

THE accommodating bottle holder shown in the accompanying illustration is designed principally for the convenience of the pen-and-ink artist.

The device does a great deal more than simply to provide a stand for the inkwell. It has a top section as well as a base, and this top section contains two disks to cover the bottles used, thus doing away with cork bottle-stoppers. Each of these disks is provided with a quill which dips down into the bottle when pressure is exerted on the finger-piece of an attached arm which is led from the outer surface of each disk to the base of the stand. Additional pressure causes the quill to rise out of the bottle, bringing with it a drop of ink which it feeds to the point of the pen held to receive it. In this way the evaporation of the ink is prevented.

Different colors of ink may be kept in the separate bottles. A small basin is provided at one side of the wells to hold a supply of water, and cleaning cloths for the pen points. Complicated as the contrivance seems to be, it requires only a slight pressure of the finger on one of the arms to raise the top and elevate the drop of ink for the pen. The economy of time and of ink is apparent, since there is no clogging of the ink from dust, no evaporation, and no cork stopper to be removed each time the bottle is used.



To take the picture the camera is held tight against the finger print and a lever is pressed

A Special Finger-Print Camera for the Modern Sherlock Holmes

FOR police officers and others who have need of getting finger-print evidence from material that cannot be preserved or removed from its environment, a special camera has been perfected. It takes a photograph of the finger print wherever it may be. In operating the camera no photographic skill or experience, nor even a tripod is necessary. The camera is held tight against the surface of the door, ceiling, wall paper, or wherever the finger print has been made. The shutter release lever is then pressed down; this automatically closes the circuit to the four lamps inside the camera and thus lights them, providing the illumination for the exposure. The necessary current is provided by storage batteries inside the camera.

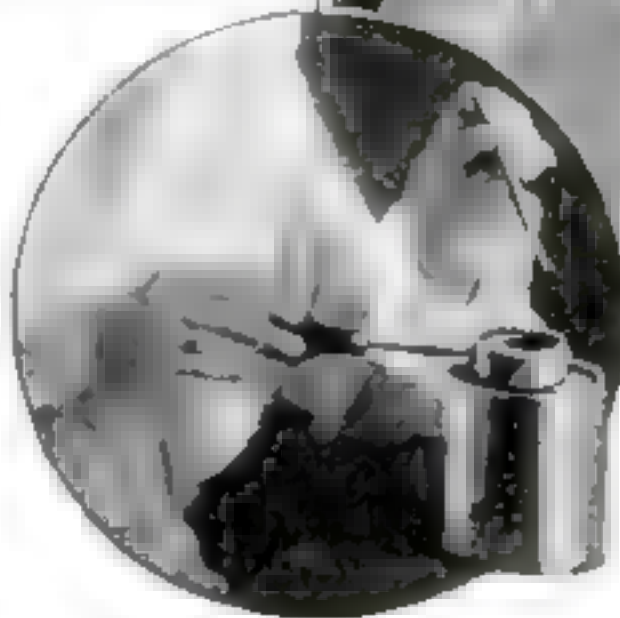


Details of the combination ink-bottle holder, ink-feeder and stopper, for the artist's use

Fuel From Waste Paper—A War-Time Economy

A GROUP of Long Island women have devised a means of cutting down their coal bills by using waste paper for fuel. The waste paper—old newspapers, wrapping paper, and card-board which may accumulate about a house is torn into small pieces and put into a watertight receptacle. Boiling water is poured over it and it is set aside until the mass becomes soft. If it is put to soak in the evening it will be ready to handle the following morning. The mass is then formed into balls about four inches in diameter. The balls may be dried in the sun or in the oven. As soon as they are thoroughly dry they are ready to use.

These paper briquets are said to be a very satisfactory substitute for coal. At any rate, they are capable of augmenting the regular coal supply to an appreciable extent. They catch quickly and burn more slowly than might be expected.



When the solder is melted, the lifter is inserted in the puncture in the cap of the can, and ring and cap are lifted off together. At left is the hot ring for melting the solder.

A Fountain Ink-Eradicator. It Works Like a Pen

EVERYBODY carries a fountain pen. Why not fountain ink-erasicator also? That is the underlying idea of an invention patented by Robert G. Mason, of Brooklyn, New York. Two thin tubes holding eradicating solutions, fit in the rubber holder. To make an erasure, the cap on the lower end of the holder must be removed. Then the feeding valves in both tubes are released allowing drops of the solutions (chloride of lime and citric acid, each in its own tube) to moisten the spot and wipe out the ink.



The two tubes for the ink-eradicating solutions fit into the thin holder which is about the size of a fountain-pen case

A New Can-Opener Which Does Not Destroy the Can

THE high cost of cans for preserving fruits and vegetables can be materially reduced by the use of a simple device which unseals the cans so that they can be used again and again.

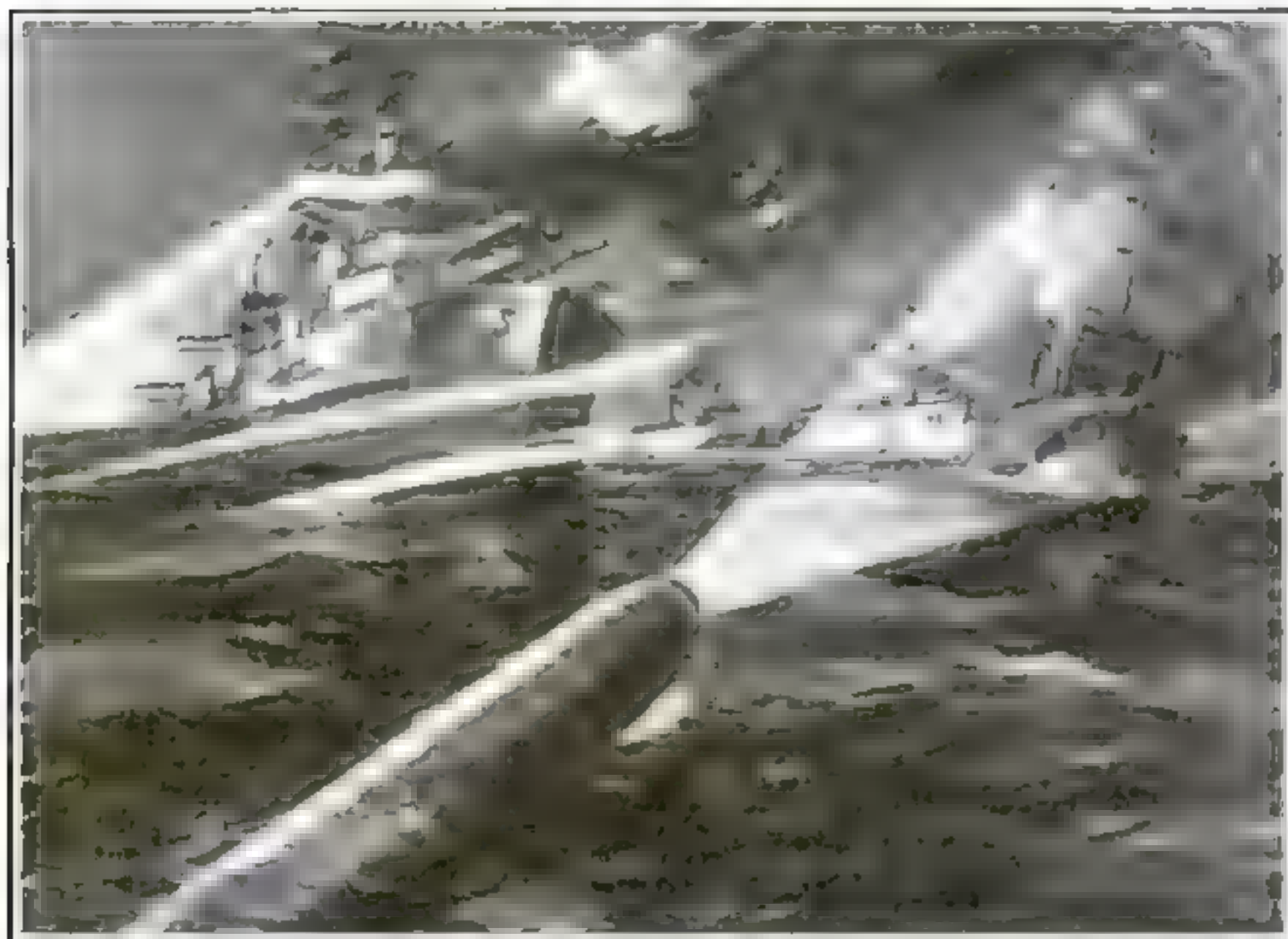


You first melt the solder around the cap on the can with the heated ring as shown in the small circular photograph above. Before applying the hot ring, you must puncture the cap; for, unless a hole is made in the cap, the atmospheric pressure of fifteen pounds to the square inch would hold the cap to the can as if by suction. When the solder is melted, the pick, or lifter, (shown held in the right hand above) is inserted in the puncture made in the cap, and the ring and cap are lifted off together.

The cans should be scalded and well washed with soda.

Fighting at Night with Searchlight Torpedoes

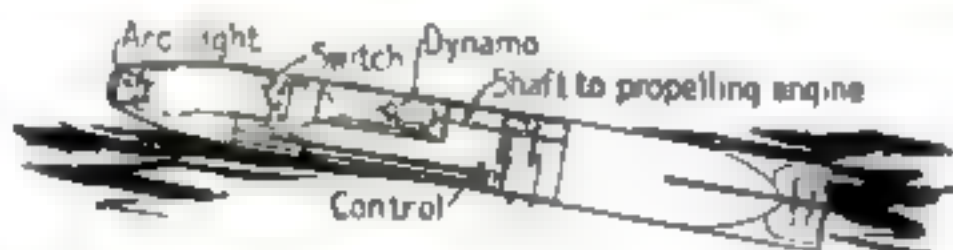
The torpedoes carry searchlights which are lighted by means of a time fuse when the enemy ships are almost reached



One by one the torpedoes are launched. They curve and glide about, revealing the enemy's position but not that of the home fleet. Below is shown the plan of the torpedo in detail

A FLEET which could illuminate the battleships of its enemy and be itself unseen would stand in a good way to whip the best navy afloat. Torpedoes for carrying out such tactics have already been developed by Alphonse Fernandez, a Spanish inventor. Not gunpowder, but a brilliant searchlight is the charge of these torpedoes.

Imagine yourself on a fleet whose searchlights have just flashed upon several hostile craft in the distant darkness. Out go your lights, your stationary searchlights also, for you do not wish to give your next maneuvers away. As your ships start at once to detour, the torpedoes are made ready. These are constructed and propelled like the regulation, high-explosive



torpedo. The gyroscopes in them are set to steer the torpedoes on a circuitous path towards the enemy.

The timing gear is also adjusted to trip the electric switch and to turn on the arc-lights after the torpedoes have gone a sufficient distance from you. Everything being now ready, the signal is given and one after another the torpedoes are launched!

They curve round and finally glide straight towards the ships of the enemy without revealing your own position. The enemy may try to dodge the beams, but before they can run out of the brilliant light of the entire school of torpedoes your gunners will have a chance at sinking, or at least, disabling their ships.

It Has Both a Pneumatic and a Solid Tire—This New Truck Wheel

DOZENS of inventors have patented wheels which are intended to have all the buoyancy of the pneumatic tire and which are blowout- and puncture-proof. The problem is difficult to solve for the ordinary pleasure vehicle, but still more so for the motor-truck. As a result, nearly all motor-trucks are equipped with the solid type of tires.

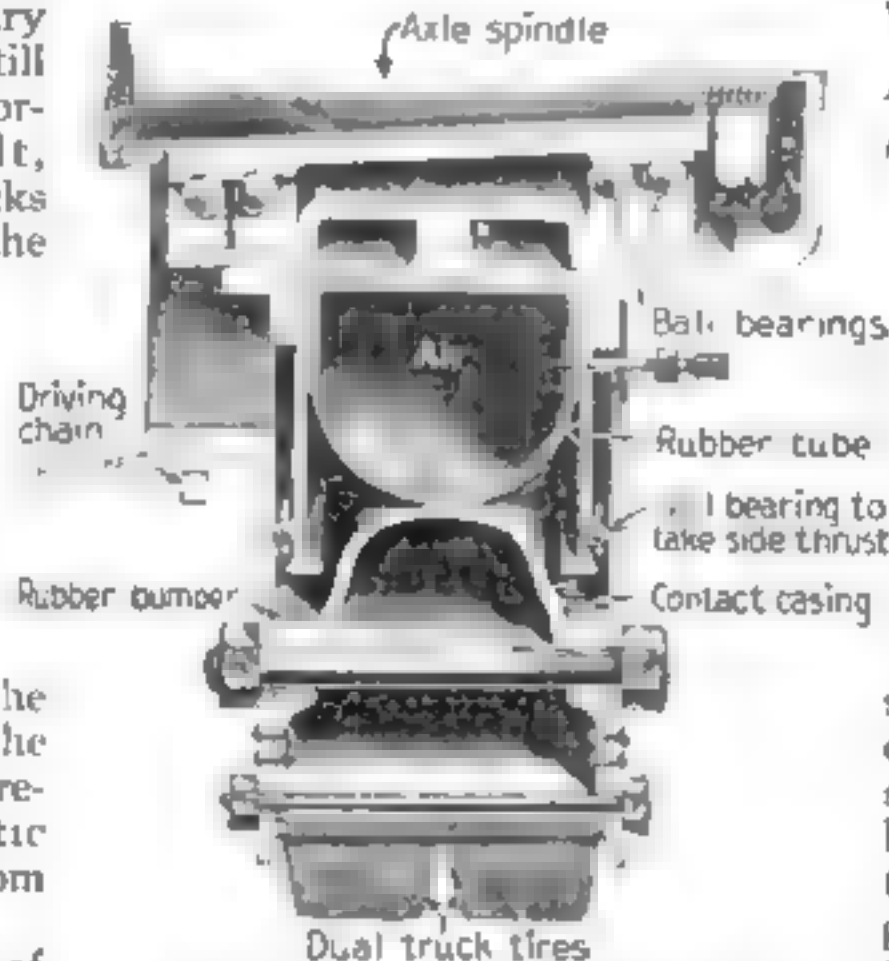
A new motor-truck tire has been invented in which both the solid tire and the pneumatic principle are ingeniously combined. The drive is transmitted directly to the rim instead of to the hub section. This relieves the pneumatic part of the wheel from the driving strains.

The wheel consists of two main parts, a hub carried on ball-bearings, with a U-shaped steel casing embracing a rubber air tube, and an outer part driven by the regular chain and sprocket and carrying the dual tires, as shown.

The outer part has a convex-shaped casing which encircles the pneumatic tube and comes into contact with it, thus providing a narrow track upon which the tire rolls when the wheel revolves. By this means the cushioning effect of the pneumatic tire is retained, with none of its disadvantages such as punctures or blowouts.

Should the pneumatic tube become deflated for any reason, the truck may still run without damaging the wheel because two rings of rubber on each end of the contact cas-

ing come into contact with the wide upper edges of the casing that hold the tube. The side thrust of the wheel when in motion is taken up by means of small thrust bearings between the inner and outer wheel parts as shown.



The drive is transmitted directly to the rim instead of to the hub section. This relieves the pneumatic part of the wheel from the heavy driving strain.

Why Do Salmon Go Annually Out to Sea?

THE rocks of the earth are having their sodium contents washed out continually, therefore the rivers of today have less salt than the streams of former years. This is the reason advanced for the regular trips which schools of salmon make every year to the deep sea. The river having become too fresh for it, the salmon must needs go out to the ocean for the saltiness necessary for its best development and comfort.

Salmon are content in the rivers all the summer and fall, during which time they spawn. The young make their first trip to the sea when they are about one year old.

You Can't Spill Ink When Pouring From This Bottle

An ink bottle which works somewhat on the principle of the non-refillable bottle, and which prevents waste and smearing of the hands, has been invented by Frank H. Silverthorne, of New York city. There is a small ball in the neck

portion of the bottle so that the flowing ink can be cut off in an instant. As a further precaution a seal is provided instead of a cork. With the seal in position the bottle will stand any amount of shaking without leaking.



Although it is opened with a simple twist, the bottle is sealed and leak-proof.



The slightest movement of the hand will cause the ball to cut off the flow of the ink.

What's Wrong with the Submarine?

A submarine boat is not perfect. Two sets of motors are needed—one to drive it on the surface and the other under water. Why not use one set only?

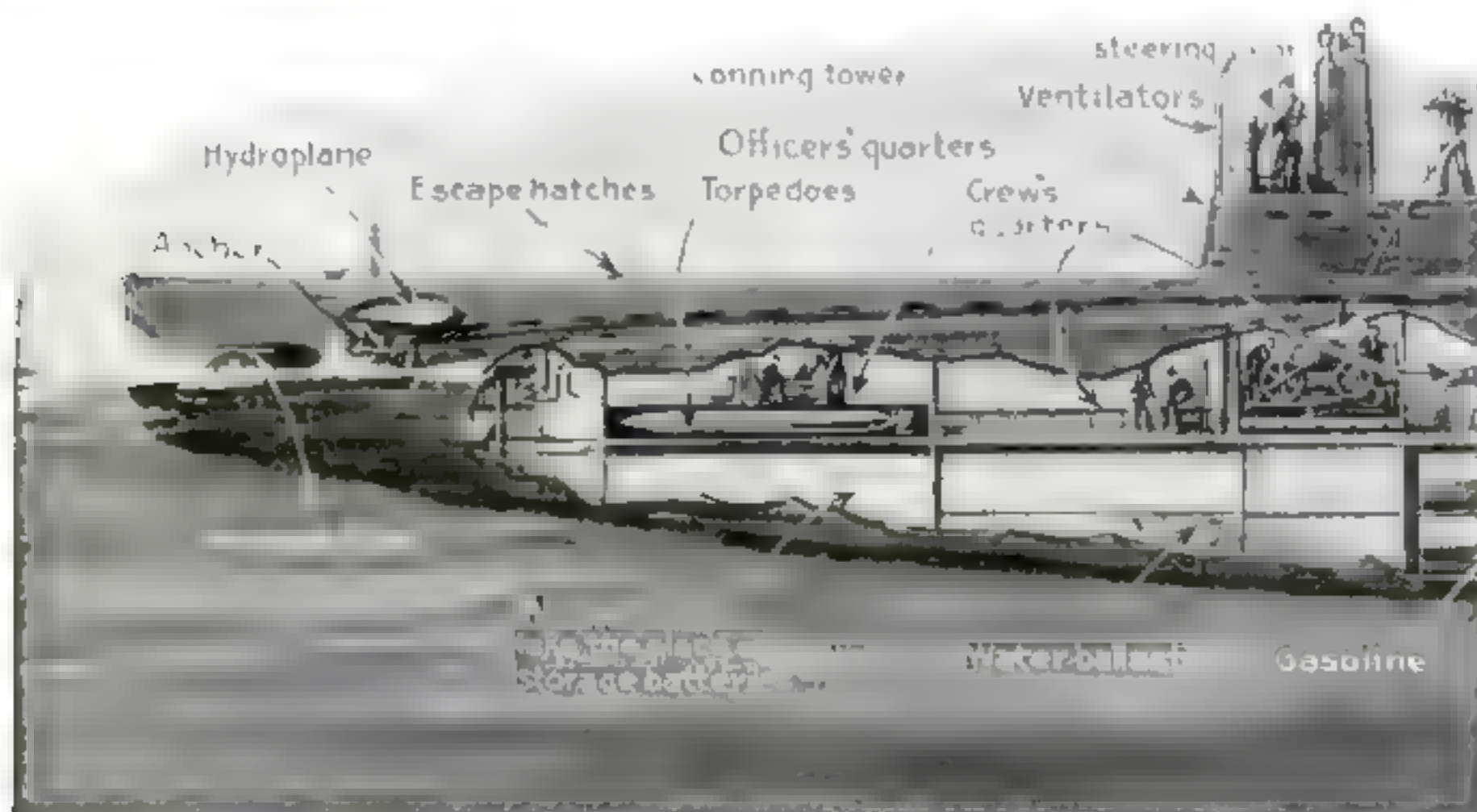
By Frank Shuman

(A submarine boat must be driven under water by storage batteries for reasons given in this article. As a result, even the larger submarines are literally packed with machinery. Some of this could be dispensed with if one set of engines could be used for surface and under-water propulsion. Moreover, the dangers attending the use of storage batteries would be avoided. Mr. Frank Shuman, a distinguished mechanical engineer, famous for his wool-degreasing machinery, his sun-power plant, his corrugated glass, his method of making concrete piles, has invented a very ingenious method of obtaining this desired end by utilizing liquid oxygen.—Editor.)

IT seems very wonderful that, after centuries of effort, men have succeeded in building boats which can dive beneath the surface of the water and come up again almost as readily as dolphins. Indeed, it is so wonderful that those who have only a general conception of the construction and operation of the submarine are apt to believe that the millenium in naval architecture has come. The truth is that for all its deadliness, the submarine is a very crude piece of machinery. The submarine serves the very useful purpose of

taking the conceit out of mechanical engineers; it reveals to them how very much they have to learn about the generation of energy.

Every submarine in the world is driven on the surface by what are known as internal combustion engines—engines which, in a general way, are similar to those by means of which automobiles are propelled. Such an engine is curiously human. It breathes air, just as you and I must breathe if we would live. A certain amount of air must be mixed with the liquid fuel of the



How Liquefied Oxygen Is Turned into Gas under High Pressure to Generate Power

Power generated from liquefied oxygen is utilized to operate first an expansion engine and then the regular explosion engine of the submarine. Liquid oxygen is intensely cold—so cold that it boils when exposed to the much hotter atmosphere. On shipboard it is kept in a container which prevents it from boiling away as much as possible. To convert it into a gas under pressure, it is pumped from the container through three successive coils before it reaches the expansion engine. In the first coil the liquefied oxygen is turned

into gaseous oxygen under high pressure; the necessary heat is supplied by ordinary sea water running around the coil. In other words, heat is absorbed from the sea water, which heat furnishes the main power to drive the expansion engine. The gaseous oxygen is next superheated by passing through the second coil, the superheating being produced by using the cooling water which has been used to jacket the explosion engine of the submarine, around the coil. The now gaseous oxygen is still further superheated as it passes

engine in order to produce that explosively rapid combustion which makes the piston move up and down in its cylinder. And so mechanism is provided which enables the engine to inhale a measured quantity of air to be mixed with a measured quantity of fuel.

Now the air within a submarine is limited in quantity. When the ship is submerged, the crew must breathe as well as the engines. Moreover, there is the problem of disposing of the gases exhausted by the engine. They cannot be ejected into the sea carelessly. They would rise to the surface of the water in the form of bubbles and would inevitably betray the course taken by the submarine. Moreover, engines are very hot, and the living quarters in a submarine are at best none too comfortable.

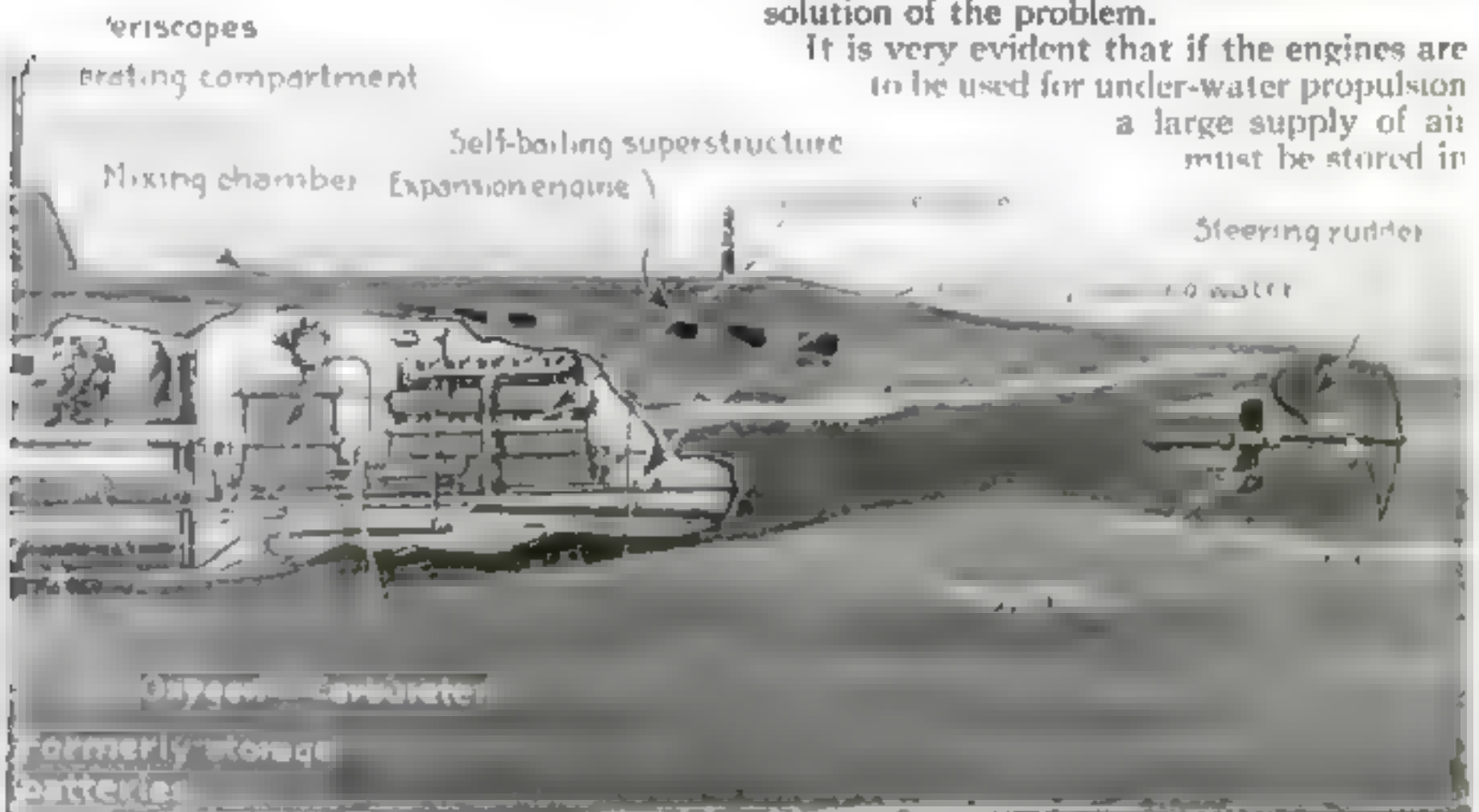
Because the air supply within a submarine is so limited and because of the very nature of the propelling engines, inventors of submarines have had to resort to the very awkward expedient of driving their craft under water by means of storage batteries. The batteries are heavy, cumbersome, and not always safe; they must

be recharged at the surface—a noisy business which takes from six to eight hours and which imperils the safety of the craft for the time being. It is said that the newest German submarines can travel under water for nearly a hundred hours. That must mean a very sparing use of the stored power. According to Lieutenant Hinkamp of our Navy, "the submarine of the present day can operate submerged at its maximum speed for about an hour. At about one-third of this maximum speed, she can operate practically twenty-four hours."

Is it not evident, as I maintain, that the submarine, mechanically speaking, is a very crude contrivance, something of which mechanical engineers should be ashamed rather than proud?

Needless to say the inconvenience and danger resulting from the necessity of using storage batteries for sub-surface propulsion have long been recognized. Inventors have made many efforts to do away with the storage battery entirely and to devise a way of using the regular internal combustion engines of the craft for under-water as well as for surface propulsion. Here, I wish to add my own contribution to the solution of the problem.

It is very evident that if the engines are to be used for under-water propulsion a large supply of air must be stored in



Sufficient to Drive the Submarine under Water at High Speed and for Long Distances

through the third coil, which is bathed by the hot exhaust gases from the explosion engine. Still under pressure, but highly superheated, the oxygen passes into the expansion engine where it helps to drive the vessel and where it is expanded to a pressure equal to that which is required to force it into the explosion engine.

In order that no visible wake may be left, the gases exhausted from the explosion engine are forced out through a sieve having many small holes. Thus the carbonic acid gas, of which the exhaust is largely composed, is finely

subdivided so that it can be readily absorbed by the sea water. This absorption is aided by the propeller which thoroughly beats up the exhaust gases with large volumes of water.

If small cruising radius and quick action alone are required rather than economy the expansion engine and the three coils through which the oxygen passes can all be cut out and the liquefied oxygen can be forced directly into the mixing tank and mingled with the proper amount of hot exhaust gases from the engine.

tanks and fed to the cylinders. Compressed air has been experimented with more or less successfully. But that does not seem to be economical. Why not liquid air, or, better still, liquid oxygen? Four-fifths of the air that we breathe is composed of nitrogen which serves the very useful purpose of diluting the oxygen that we really need and preventing us from literally burning up. Since an engine is an inanimate piece of machinery which can be constructed to meet certain operating conditions, there seems no reason why liquefied oxygen could not be used effectively. And so, I have designed the machinery which is disclosed in the accompanying illustrations and which, I am sure, will drive a submarine under water at high speed and for long distances.

An engine is driven by heat, converted into mechanical energy. Liquid oxygen is very cold. When it vaporizes and becomes a gas again it absorbs heat, or energy, from the heating agent, which combines in this case sea water and other means. To make the most of our liquid oxygen, then, this stored energy ought to be used for propelling the vessel. Hence, in the design which I here present, the gas given off by the liquefied oxygen is fed to an expansion engine, which is an engine very much like a steam engine in principle, the difference being that a compressed gas is the motive agent instead of steam. It is evident that after the oxygen has expended its energy in driving the piston of that expansion engine, it is just as fit to breathe as it ever was before. In other words, it can be fed to the internal combustion engines of the submarine to be mixed with fuel as if it had never been utilized in the expansion engine at all. This is what I have done. The result is that the me-

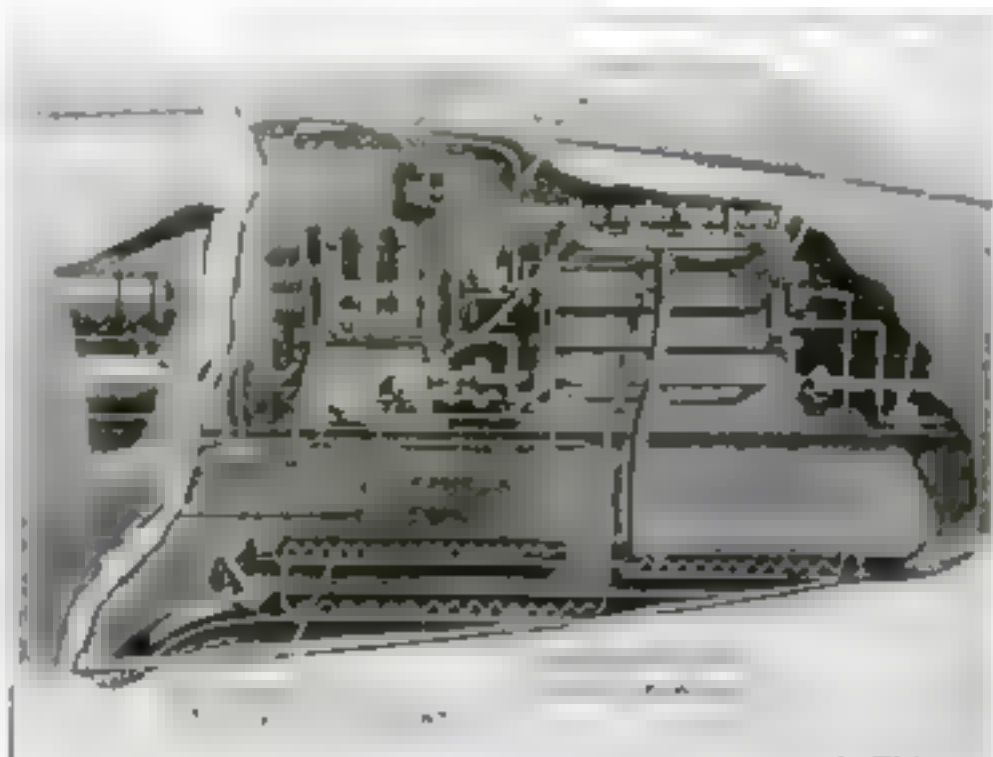
chanical energy stored up in the liquid oxygen serves to supply additional power for driving the vessel and the oxygen itself to furnish the medium without which there can be no combustion. The captions appearing beneath the illustrations describe the actual invention in such detail that it is unnecessary to dwell further upon its construction here.

I have said that the exhaust gases of an engine when discharged into the water appear as bubbles on the surface and not only betray the presence of the craft but

indicate the exact course. In order to dispose of these gases, I discharge them through an exhaust device of special type. They are sifted through millions of small holes. After that they strike the propeller, by which they are beaten up with the sea water. Since these exhaust gases are composed chiefly of steam and carbon dioxide, they will be entirely absorbed by the sea water after having been thus minutely subdivided. No be-

traying wake will be visible.

Compressed air in strong, steel tanks, could no doubt be used to drive the engines of a submarine under water. Indeed, the experiments which have been made with what is known as the Neff system, described some time ago in the pages of the *POPULAR SCIENCE MONTHLY*, have been encouraging. Officers of the navy have criticised the use of compressed air because of the wake. My objection to the system is chiefly to the nitrogen contained in the compressed air. Nitrogen is not easily absorbed by sea water; it resists combination with all elements. The whole difficulty of avoiding a wake is more easily solved, to my mind, by utilizing pure liquid oxygen. Moreover, no matter how highly air may be compressed in tanks, a liquefied gas is even more compact.



Diluting the Oxygen with Hot Exhaust Gases

Before it can be fed to the explosion engine after having been exhausted from the expansion engine, the oxygen must be diluted, otherwise it would simply destroy the explosion engine. Hence, the oxygen after it leaves the expansion engine passes into a tank where it is mixed with a certain quantity of the hot exhaust gases (dried carbon dioxide and steam) from the explosion engine. That quantity is carefully measured by a meter pump and forced through a pipe into the mixing tank as here shown. A certain amount of fuel (oil or gasoline) is forced through a carburetor and supplied to the mixing tank

Medical Men in the Army—Thousands of Them Are Needed

WHEN Uncle Sam sends his fighting forces to the front he will require the services of 24,000 officers and 120,000 enlisted men for the Army Medical and Sanitary Corps. It has been estimated that the army will need two out of every nine physicians in the country.

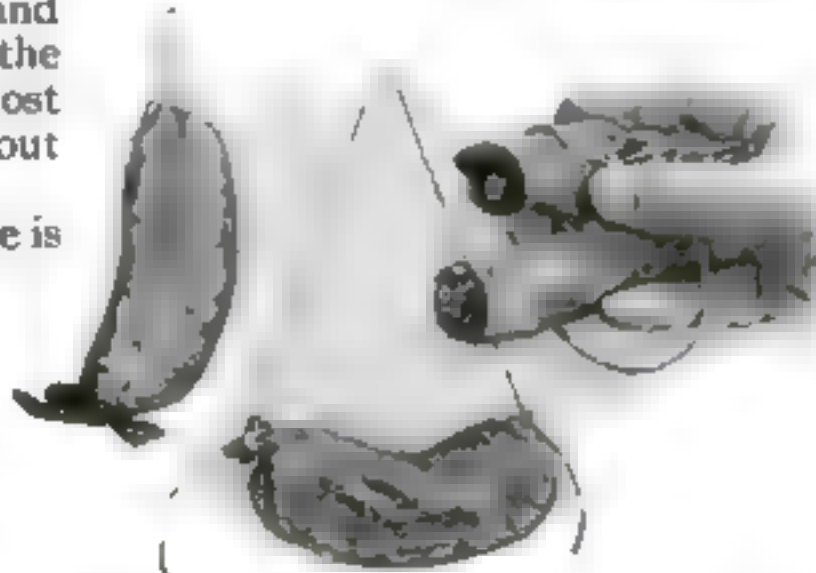
The average number of physicians receiving orders has been about two hundred a day. As fast as accommodations are ready these medical officers are sent to training camps. They go ahead of the troops in order that sanitary preparations may be made for the men.

The medical training camps at Fort Riley, Fort Benjamin Harrison and Fort Oglethorpe take care of 1,000 student officers and 1,800 enlisted men. Besides these each camp has four ambulance companies, four field hospitals and one evacuation company. That colored troops may have their own medical officers there is a training camp for colored medical and sanitary detachments.

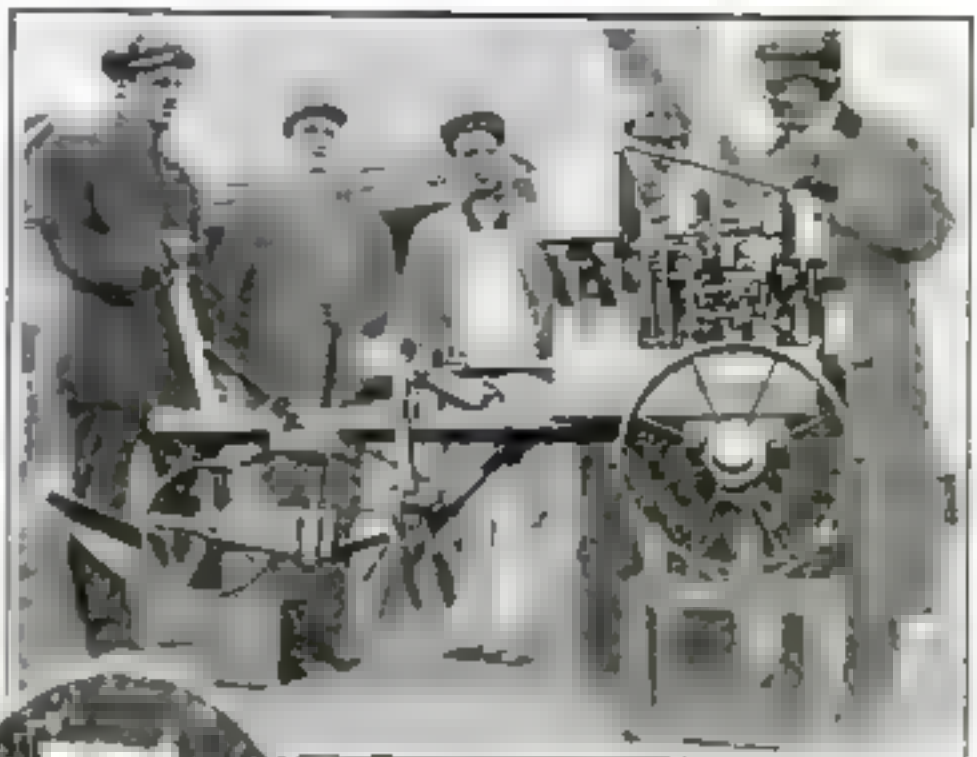
Packing Chocolate in Sausage-Links for Italian Soldiers

EXPERIENCE has proved that the most economical and convenient method of preparing chocolate for the use of soldiers is to pack it in sausage-links. The chocolate, mixed with sugar, is poured directly from the crusher-mill in which the cocoa bean is crushed, into the pendant sausage casing and tied up so that it looks exactly like a small sausage. It soon hardens and may be carried in the pocket or stored for almost any length of time without becoming stale.

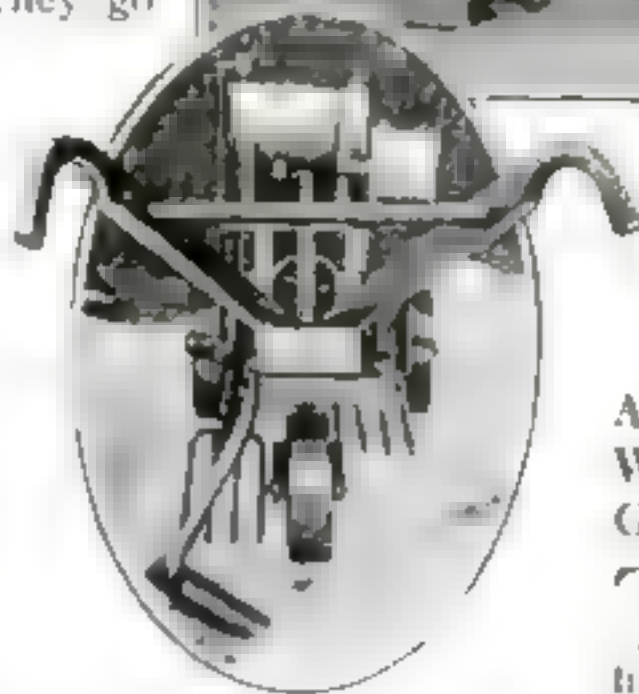
The chocolate sausage is considered by the Italians as an essential when campaigning. It is used either for the purpose of making instantly a nutritious beverage or for eating, like candy, on a long, dinnerless march.



Dietitians give chocolate a high rank for its nutrition. This is how it is prepared for the Italian soldiers so that it will not melt



The gasoline engine drives the machine ahead and the forked spades work the ground, while you simply take the plow handles and steer



A Spading Machine Which Makes Patriotic Gardening Worth While

THE average man who works during the day finds the home garden a big undertaking, *unless* he

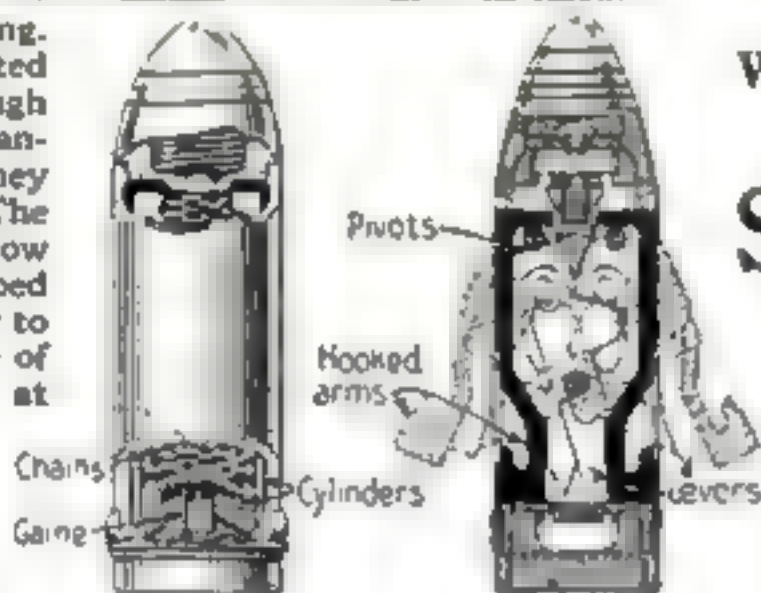
has a gasoline spading machine like the one recently rigged up in New Jersey by Raymond D. Jamesson. With it the plowing and spading are done in one-fifth the usual time and without the usual backache.

A small gasoline engine is mounted on a light framework, and this is geared up with the two spurred driving wheels. Another gearing is connected with the pivoted fork spades so that the prongs of these are given a reciprocating motion. All you have to do, therefore, is to take the plow handles and steer the machine; the eight horse-

power engine will drive it; the spades will dig up the ground; the forks will break up the clods of earth, and a special device will open up the furrow. On the return trip this same device will cover over the seeds and the center wheel will press them down. The hand spade method is ancient compared with this.



A chain shell exploding. The heavy chains weighted at the ends tear through the heaviest wire entanglements as though they were spider webs. The shell at the left shows how the chains are wrapped around the gaine ready to spread out at the time of explosion. The shell at the right has a pair of cutting arms which cut through entanglements as easily as you can cut a thread with scissors.



Shells with Scissors Attachments That Cut Wire Entanglements

THERE seems no limit to what the new shells can do. One of the latest shells has a sort of scissors attachment which, when released by the explosion, will cut through the strongest wire entanglements. Another releases a number of short chains when it explodes. These chains are sure to wreck anything they touch.

The scissors shell has an opening in the casing through which the cutting arms project. They are slightly recessed in order to avoid wind resistance. The arms are attached near the nose of the projectile. They are mounted on steel studs in such a manner that they can rock and expand in order to throw the free ends out-

ward at the base of the shell.

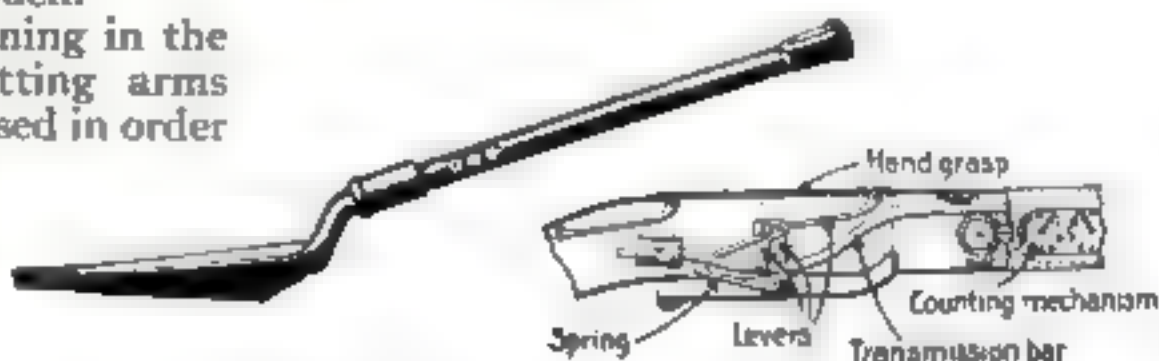
The fuse is made in the ordinary way and behind it is a chamber for the explosive charge. The projectile is fired just as any shell is fired. The explosion releases the cutting arms and they cut through any object with devastating force.

The chain shell is constructed similarly except that short chains are wound around the gaine and separated by disks which keep them in place until the projectile is emptied. Sometimes the chains are weighted heavily at the ends. When the explosion takes place the chains fly out with fearful force and in addition to their high-speed forward movement they rotate rapidly. Needless to say, where they hit something, there is nothing left.

Weighing Your Coal by the Ounce or the Pound

SOMETHING new in shovels has been invented by David Moffatt Myers, of New York. Perhaps the inventor thought that the soaring price of coal meant that hereafter it would be weighed by the pound. His shovel weighs every ounce of coal.

This paragon among shovels looks like any other iron shovel except for some embellishments on its handle. It has a sliding hand-grip near its pan. The grip is held by levers and a spring. When the stoker grips the handle and loads the shovel the load naturally shifts to his left hand. The spring allows his grip to move upward in proportion to the weight of the coal. Links transmit the motion to a toothed bar, which turns a counting mechanism.



As the coal is shoveled, the total weight may be read in the exact number of pounds and ounces.

Open Your Mouth and Let the Doctor Flashlight Its Interior

AN interesting little device recently invented for the convenience of physicians and dentists, is an automatic mouth inspecting lamp.

A small electric bulb is fitted into a short tube which is itself hinged to a larger cylinder containing the standard flashlight batteries. A wooden tongue-depressor is attached to the tube. When the surgeon presses down your tongue with this, the tube is swung slightly on its hinge. This action produces the light.



When the surgeon depresses your tongue, the action closes an electric circuit and illuminates your mouth

started, this system supplies practically a constant circulation, so that when the engine is working under a heavier load than usual, and therefore requires a greater circulation, it does not get it. This lack causes overheating.

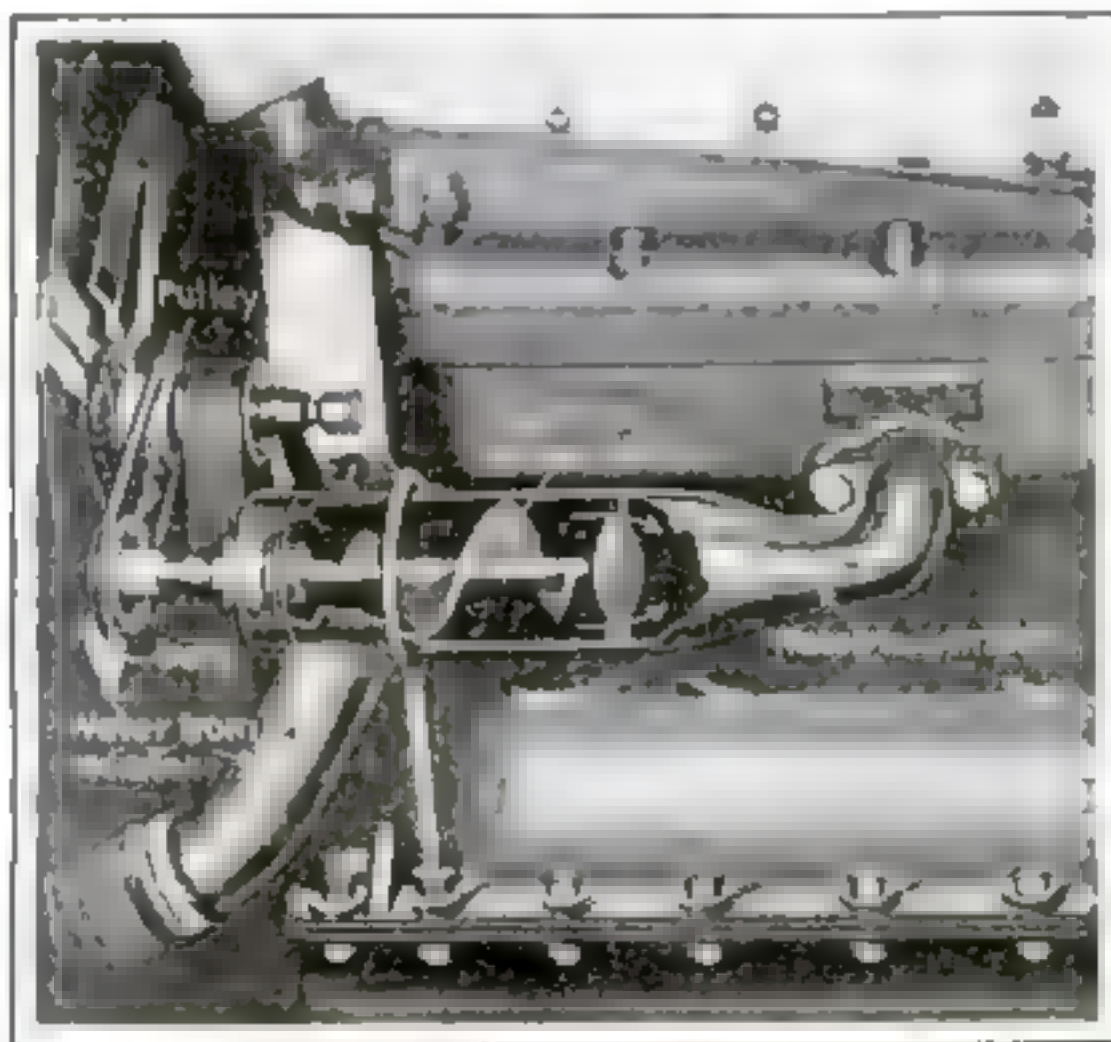
This deficiency is overcome by the simple pump shown below. It consists of a screw-like blade working in a short barrel inserted in the regular Ford water line between the radiator and the engine. The blade is revolved by means of a small belt and pulley driven by the big radiator fan-shaft. The faster the engine revolves the more water is circulated.

Preventing the Ford Engine from Overheating—A Simple Pump Does It

THE engine of the Ford car often overheats in the hot weather when driving fast or working under a hard pull because of the thermo-siphon water cooling system employed. In this system the water circulates from the radiator to the cylinders and back again in accordance with the natural law which causes hot water to rise to the top while cold water drops to the bottom. After the engine is once

Lucky and Unlucky Telephone Numbers—In Japan They Affect Your Bill

OUR only unlucky number is 13. In Japan they have two unlucky numbers—42 and 49. Nobody wants either of these numbers for a telephone call, simply because the former is pronounced "shini," which means "to die" and the latter is pronounced "shiku," which means "death." The luckiest telephone number in the estimation of the Japanese business man is eight, which suggests prosperity.



The water circulates continuously from the radiator to the cylinders and back, forced at times by a screw-like blade which is revolved by a belt and pulley

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

Italy's Huge Bombing Triplane

A machine which is intended
to do the work of heavy guns

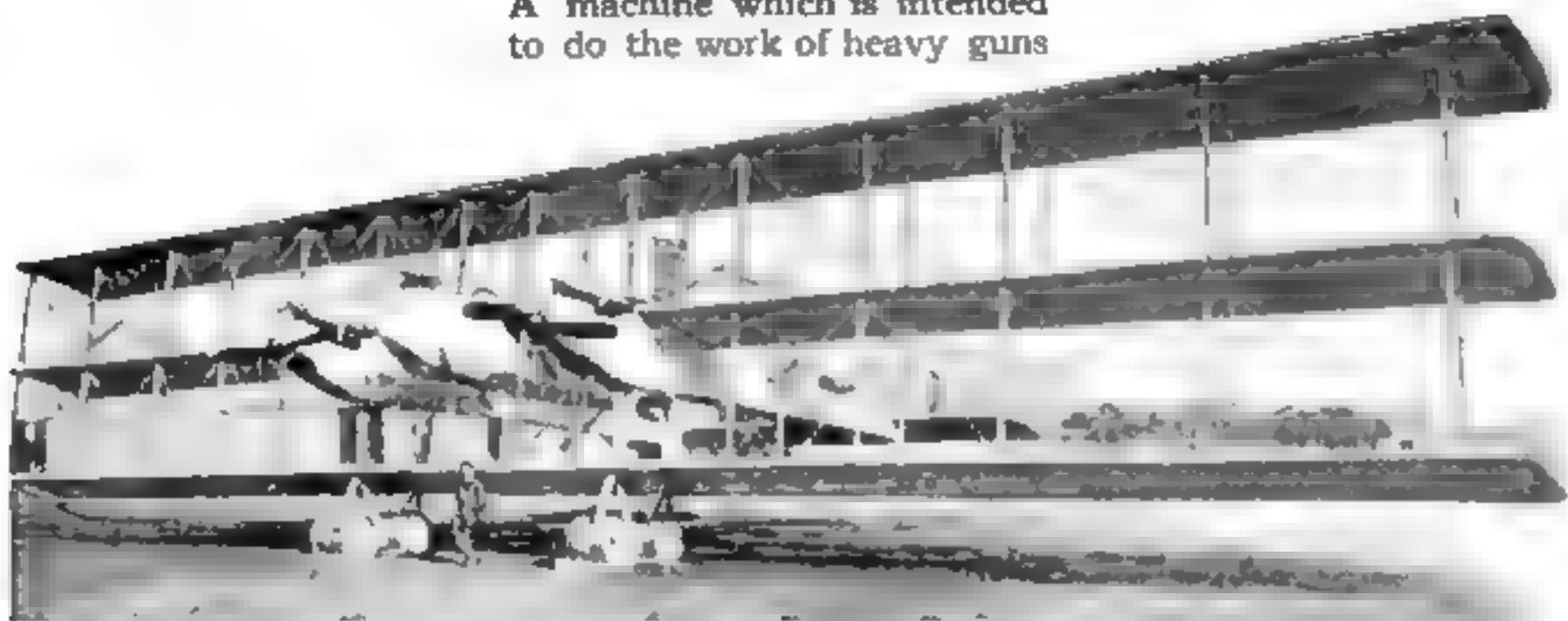


Photo: Bernard Levy

The shock of landing is tremendous. Notice how solid are the wheels on which the machine alights, how substantial is their frame and how carefully they have been placed to distribute the shock

THE POPULAR SCIENCE MONTHLY has already devoted space to the huge Sikorsky biplane used by Russia early in the war—a machine which had a body almost as big and comfortable as a Pullman car. German observers called it slow and cumbrous.

In spite of the disadvantages of such huge machines, all the Powers have experimented with them. Their chief merit is their load-carrying capacity. Now comes Italy with the Caproni type. According to Major R. Perfetti, head of the Italian Aeronautical Commission in the United States, the Caproni climbs 3,250 feet in thirteen minutes, 6,500 feet in twenty-seven minutes, 10,000 feet in sixty-seven minutes. It carries three men, three shell guns, 7,500 pounds of bombs and fuel for six hours. Its 900-horsepower engines drive it at a maximum speed of eighty miles an hour.

The Italians regard this huge bombing plane optimistically as the equivalent, or rather the superior of the long-range cannon. To be sure, it can drop explosives far beyond the range of the heaviest artillery; but it must not be overlooked that bombs cannot be dropped with the accuracy of shells without exposing the machine.

The Caproni is an object lesson. To lift an enormous load, great wing surface must be depended upon. A biplane is impossible, because the span would be too great. Hence, the Caproni is a triplane, and even then the span is no less than one hundred and ten feet. Carrying surface is

thus obtained in a small compass and with deeper and stronger trussing than would be possible in a biplane. But that advantage is purchased at the expense of head resistance. Surface cannot be piled on surface without paying the price in power.

The distribution of the planes in three decks was not enough. In order that the immense structure might be solid as a whole and yet not too heavy, power must be generated by three engines, because three engines can be distributed. Each of these engines is of three hundred horsepower. The distribution of the engines over a full third of the wing span lowers by that much the leverage of the weight on the truss. Since irregularly shaped masses as they move through the air exert a considerable retarding effect, each engine is, of course, enclosed in a long streamline body. The middle body is the shortest; hence its three-bladed propeller is mounted in the rear. The two outer bodies have two-bladed front propellers.

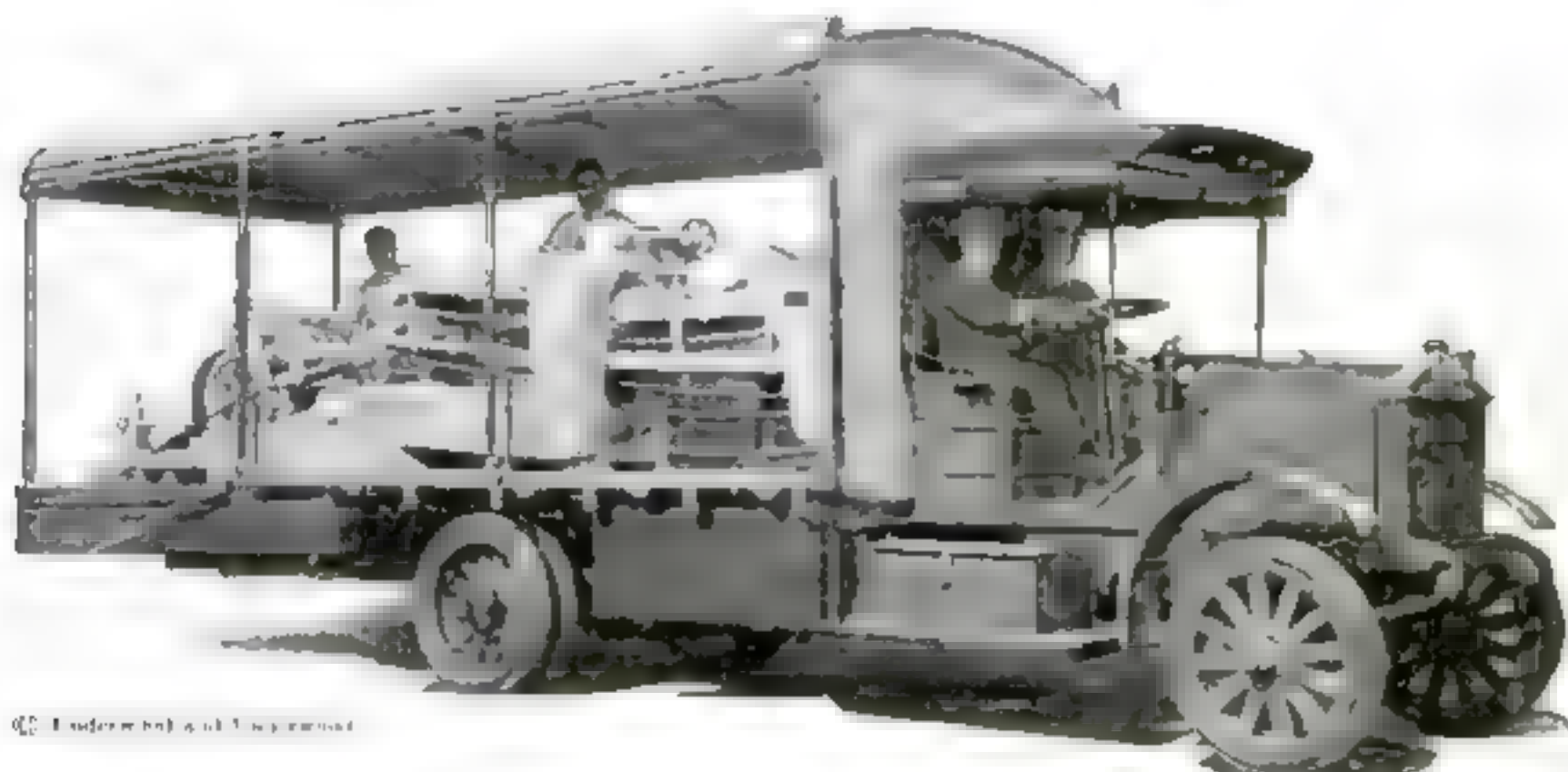
These two outer bodies hold the tail between them far more rigidly than would be possible in single-fuselage construction.

Curtiss in his small fast triplane ingeniously showed that it was possible to use only three struts on account of their inherent strength and that the head resistance increases with the number of struts.

The latest warplanes with their high landing speeds, are plainly expected to land only at carefully prepared grounds. That policy removes a grave objection to mere size.

The Portable Army Bread-Mixer

It makes six thousand loaves an hour



The bread-making outfit is mounted on a specially constructed motor truck so that it can follow the troops. It is operated by current from the truck engine or from a separate motor

AGAIN has one of the necessities of this great war proved itself the mother of invention and produced a machine to do work that previously had only been done by hand or by expensive and cumbersome installed machinery. This time it is a portable army bread-mixing machine capable of mixing the ingredients into dough; molding the dough into any shape desired and dividing it into predetermined weights which can be regulated by the simple movement of a hand-wheel.

With a crew of five men, the machine will make six thousand loaves of any size, weight or shape in one hour. This is the same amount of work which now requires the services of 112 soldiers mixing bread in the field by hand work. In addition, the dough is machined in a sanitary manner, the finished loaves being dis-

charged from the machine directly into baking pans ready for the ovens.

The mixer dumps the dough into troughs, where it rises. It is then removed to the machine proper where it is divided and molded after being rolled and kneaded as it passes through on chain-driven belt conveyors.

The entire outfit is mounted on a specially long wheelbase motor-truck so that it can move forward and follow the troops or change its position as required. The bread-making machinery is carried wholly within the motor-truck body. This

has low sides to fold down as platforms on which the men can stand, and canvas side-walls which are extended to form a tent twenty-four feet wide and twenty-eight feet long when the outfit is set up in the field for operation. Current is provided from the truck engine.



The bread is mixed, kneaded, weighed, formed into loaves and discharged into baking pans—all by machinery

Building Ships of Cast-Steel

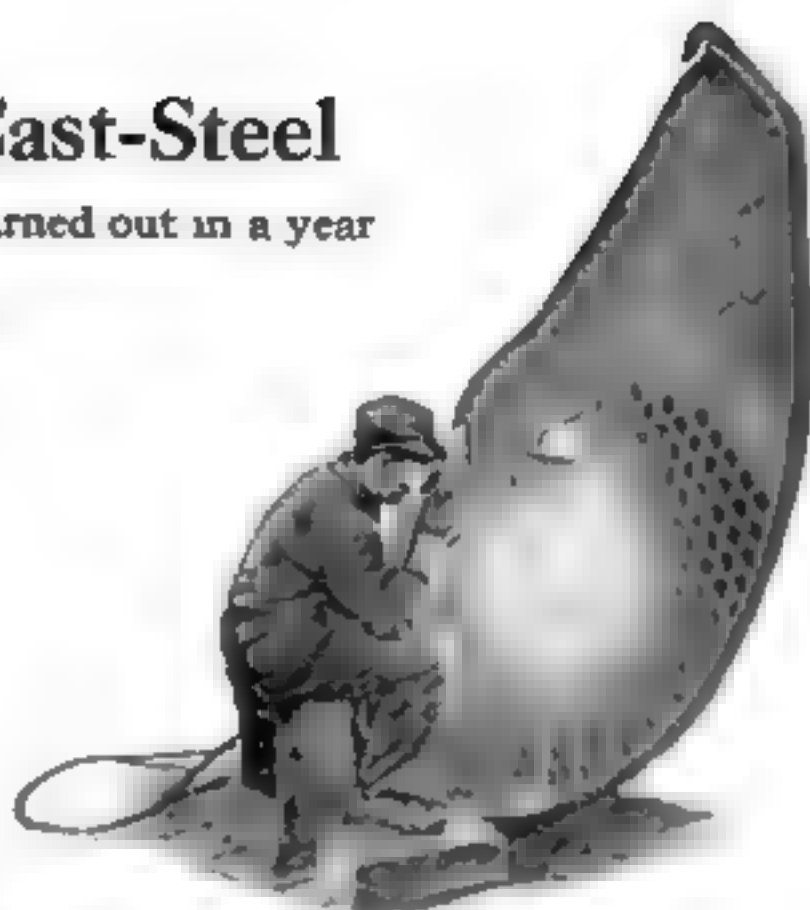
Six million tons of such vessels could be turned out in a year

By Joseph Brinker

NOW comes the cast-steel ship. The purpose behind its proposed construction is to enable a large ocean-going tonnage to be built rapidly without further straining the much-overtaxed steel rolling mills of this country. According to its inventor, Myron F. Hill, a New York city patent attorney, standardized cast-steel ships can be built in much less time and at a much smaller cost than the ordinary fabricated steel-plate type. He further predicts that 6,000,000 tons of such ships could be turned out in one year if built according to a standard plan.

While the use of cast-steel in ship construction is entirely new so far as merchant vessels in any part of the world are concerned, it has been stated by Lord Yarrow of the British Admiralty that the latest U-boats are being rushed to completion at a surprising rate by the use of standardized cast-steel sections put together in much the same fashion as Mr. Hill proposes for the cast-steel cargo boat.

According to the present plans, which have been recommended for trial by the ranking naval architect of the Shipping Board and are now being drawn up for a rating by the Lloyds, the standard cast-steel cargo steamer will be a vessel four hundred and two feet long, fifty-three feet beam and thirty-four feet molded depth. She will have a displacement of approximately twelve thousand two hundred tons when fully loaded and a cargo capacity of nine thousand, one hundred



Employing the Electrical Welding Process

The inventor proposes to use the Wilson electric process for welding together the various sections of the cast-steel ship. Above is shown a workman with the welding tool, used in this process, in one hand, and a wire screen guard to protect his eyes from the intense light and heat in the other. He is welding the tubes of a locomotive into the boiler headsheet.

tons. She will not differ from the ordinary cargo steamer in shape, propelling engines or other machinery but simply in the hull and the bulkheads, all of which will be made of cast-steel sections welded together by the special Wilson process, which has proved very successful in commercial work and is now being extensively employed in restoring the damaged and broken parts of the many German ships taken over by our Government.

The straight-sided portion of the cast-steel ships, or that central three-fifths of the length of the vessel amidships, will be made up of sections from ten to twelve feet wide in the lengthwise dimension of the ship. For an ordinary two-decked vessel, each of these sections will be formed of five steel castings welded together at six points in the same transverse plane in addition to the welding required to join one section to those



Before and After the Welding

At the left, a cracked bell with the crack cut into the form of a V to admit the welding material. At the right, the same bell after the crack has been repaired. Note the laminations of the welded material and its rough surface. The roughness may be ground almost entirely away. In the center above, is the Wilson welding tool showing the bar of manganese alloy which is welded in the grooves



immediately adjacent on each side. The five steel castings consist of one extending clear across the vessel at the bottom and forming the inner bottom for water ballast or fuel oil; two identical side castings, each extending from the top of the double-

bottom unit to the upper deck, and two cast-steel deck-beam sections, one for each deck. The six welds in each transverse section are made between the two deck beams and the vertical side casting and between it and the double-bottom on each side, giving three welds to each of the transverse sections, a

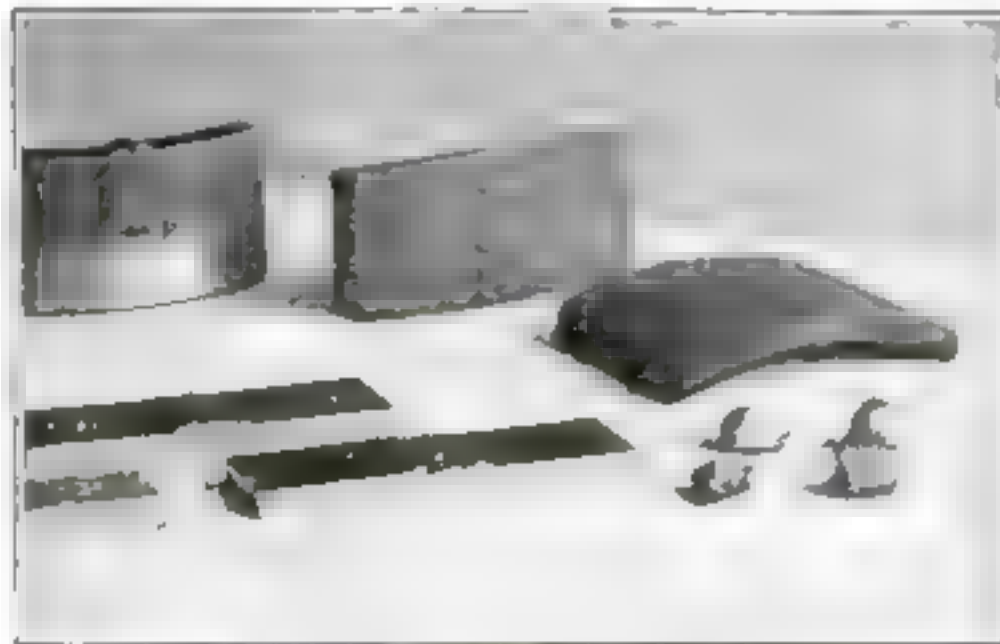
total of six in each of the five castings. The thirty-foot ship side castings and the fifty-five-foot double-bottom unit may seem unwieldy, but equally large and more difficult castings, such as battleship stem

pieces, rudder posts, etc., have been successfully turned out for many years past. Cast steel has driven out the riveted forms of locomotive tender bed-frames, car truck frames, vestibule ends for steel cars and Pullman coaches, etc., where excessive vibration

has caused the rivets to loosen and where abnormal strains, such as must be encountered by ships in a heavy sea, have bent the rolled steel frames and necessitated costly repairs and overhauling.

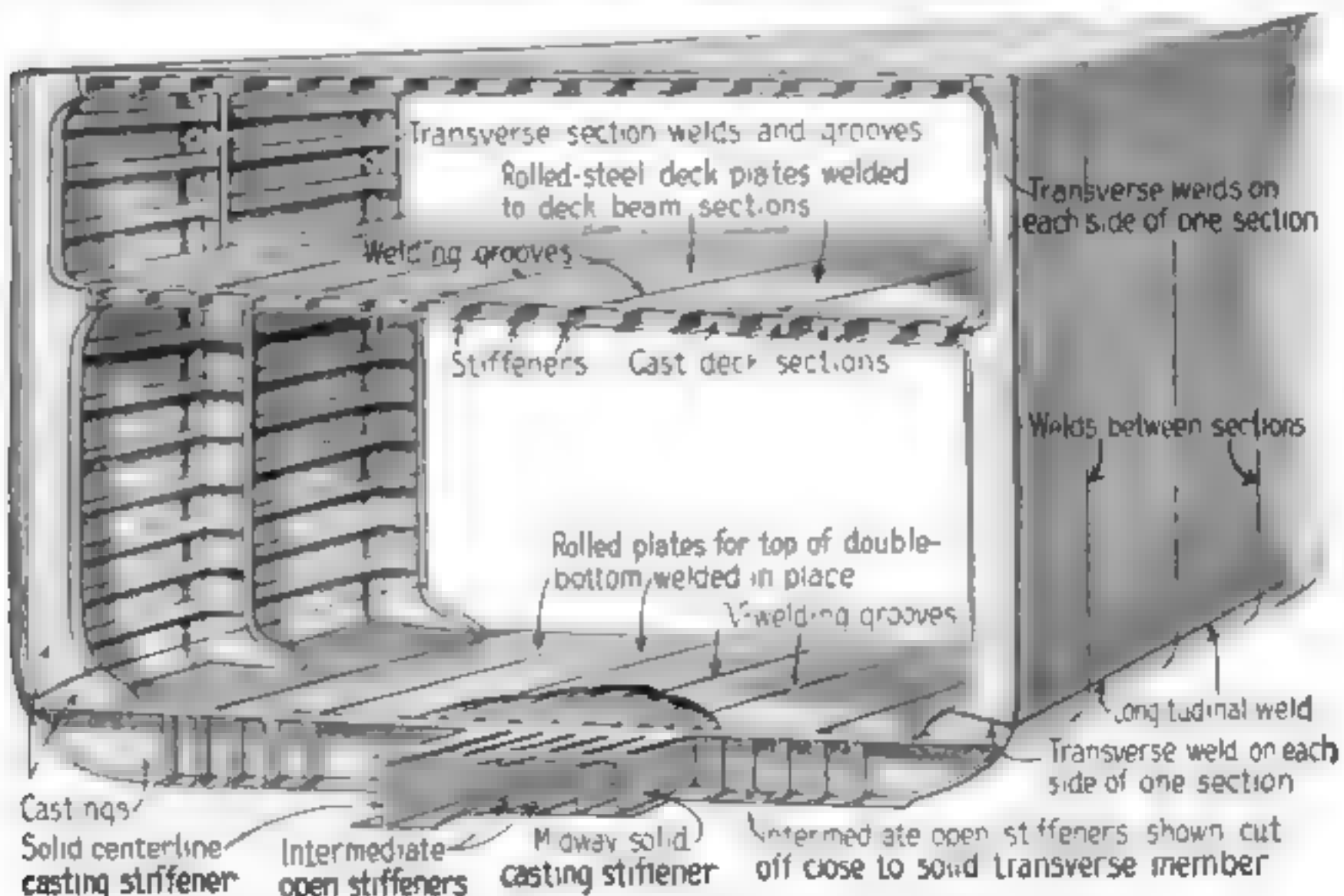
The cast-steel ship will have no rivets, liners, lap or butt joints in the shell-plating, bulk heads, double bottoms,

etc., and no frames, reverse frames or the usual great number of angle irons and brackets which go to make up the ordinary fabricated ship. Some of the weight of these various parts will be used to increase



Examples of Electric Welding

Note the V-shaped groove cut in the rectangular piece in the foreground. Note also in the piece of steel in the left background, how the roughness of the weld may be ground off so that the position of the welded place will not be noticeable.



A Perspective Transverse Cross-Section of the Cast-Iron Ship

The five major castings from which the ship will be made are the double-bottom casting, the two vertical side castings, one on either side, and the two cast-iron deck sections. Note the strengthening ribs in the side castings, somewhat similar to those used in the longitudinal method of ship construction, and the manner in which the rolled plates welded on the top of the double-bottom and deck sections are employed to provide thoroughly water-tight floors.

the thickness of the shell portion of the castings for greater rigidity, but the greater part will be eliminated, thereby reducing the dead weight of the vessel to below that of the ordinary fabricated type. Besides, there will be no interstices between the plates of the ordinary ship to permit of corrosion.

The outer or skin side of the castings in contact with the water will be smoothed off by means of liquid cement and finally painted.

According to Mr. Hill's plans, the castings will be made by the machine method of block molding which does not require any great amount of skilled help and in which the casting loss is said to be only two and one-half per cent. Of course the castings will have ribs, as required in the molding process, but these ribs will serve the

dual purpose of providing for the longitudinal and transverse strength of the hull itself.

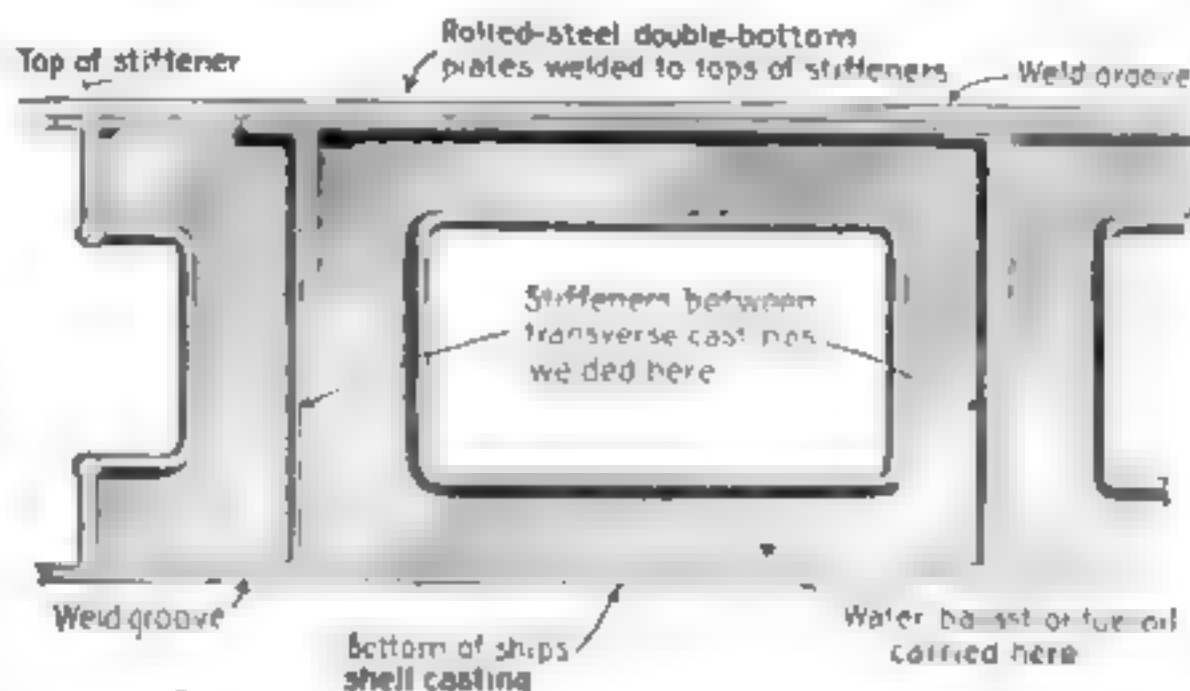
The inventor plans to weld the castings together by the Wilson process in which special V-shaped grooves along the welding edges will be filled with a manganese alloy by means of an electric arc across the end of the alloy rod held by the welder, and the casting itself. The method of keeping the melting current uniform as secured by the Wilson process is said to make it possible

for a joint to be made which has a strength of one hundred and twenty-five per cent of the casting itself or a joint actually stronger than the parts joined.

As Mr. Hill has laid out his plans, he would have big foundry-shipyards at deep water where castings could be made and

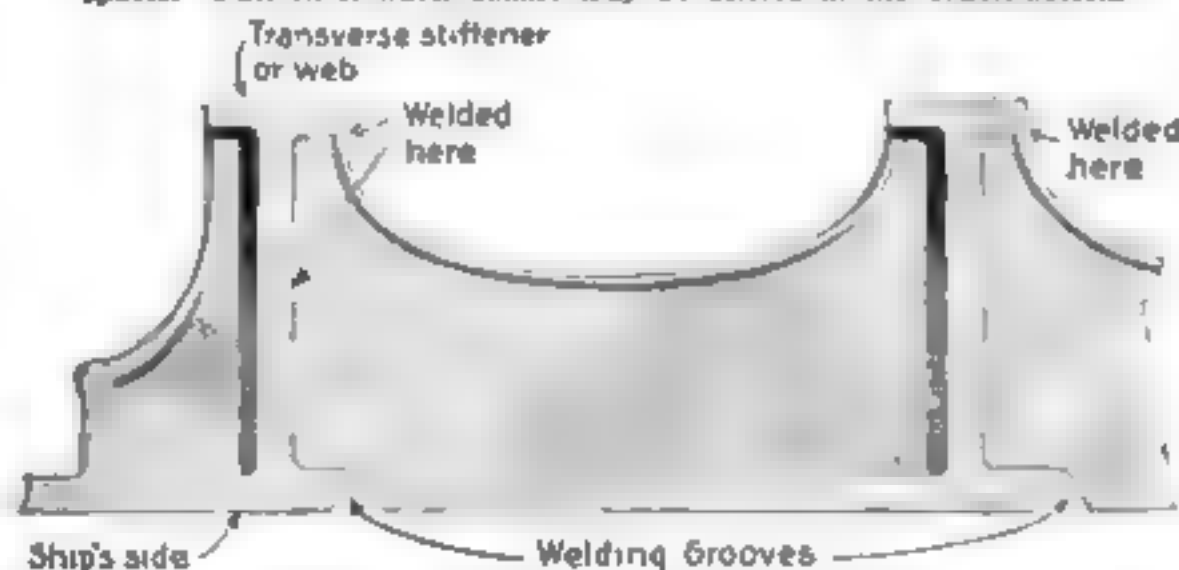
then placed directly on the launching ways by means of the usual traveling crane outfits. After the various sections were set up in order and welded together, the ship could be launched and outfitted with engines and boilers according to present-day practice. The yards would have open-hearth furnaces capable of turning out five-hundred thousand tons of ships a month. If blast furnaces are to be used until the open-hearth type are ready, the supply of

pig iron can be drawn upon. According to the inventor's further plans, one gang can build an open-hearth furnace in forty-five days; two blast furnaces have just been built by the Cambria Steel Co. in fifty-seven days, the electric crane outfits can be built in two months; the launching ways in from four to five months, and the welders and the workmen trained to handle machine molding in from two to three months. The plants could be located at launching points readily accessible to railways.



A Longitudinal Cross-Sectional View

This was taken in the double-bottom of the cast-iron ship looking toward the centerline and showing the transverse I beam members and the manner in which the stiffeners cast integral with one I beam section are welded to those adjacent to it. Note also the lightening hole in the stiffeners and the manner in which the rolled steel plates are welded to the tops of the stiffeners to provide a water-tight floor. It is also seen that the bottom of each section forms the side or hull of the ship with V-shaped welding grooves at the ends of each section as shown. There are no inter-spaces. Fuel oil or water ballast may be carried in the double-bottom



Looking Down on the Top of One of the Side Sections of the Ship

This view shows two of the transverse stiffeners corresponding to the ribs of a wooden vessel. Note also how each section is welded to that adjacent to it and the special V-shaped welding grooves in the ship's side. These grooves will be filled with a specially prepared manganese alloy

Holding the Crowd Before Your Show Windows

SINCE it is next to impossible to get all the passers-by to come inside your store, the next best thing is to talk to them as they pass. The electric moving display sign shown in the illustration below is designed for this purpose. It has a moving tape across its display surface, on which as much as five hundred feet of reading matter can be brought to the attention of the passing crowd. This tape is of cloth and moves continuously in one direction as long as the current is turned on.

The motor which furnishes the power is concealed inside the cabinet of the device, with the tape box. Either direct or alternating current may be used. The tape can be changed as often as desired. The advertisements are made as newsy as possible and are interspersed with appropriate witticisms. Sometimes prizes are offered for finding a misspelled word or a word purposely omitted.

In charge of an ingenious operator this device ought to keep a crowd in front of the store window all day long, and at night you could go home and leave it still talking convincingly to the passers-by, electric lights, shielded and hidden by a reflector, illuminating the reading matter.

Naturally, the people who stop to watch the sign will also take notice of the merchandise on display in the window.

Dolls That Proclaim What the Fashions in Silk Shall Be

YOU would not think that serious-minded business men would have dolls made just for their especial benefit. But they do. However, these dolls are not for purposes of amusement. Since the war the fine silks from France have been difficult to obtain. This has put the American silk manufacturers on their mettle and they have been producing some splendid silks which rival those made in the French mills.

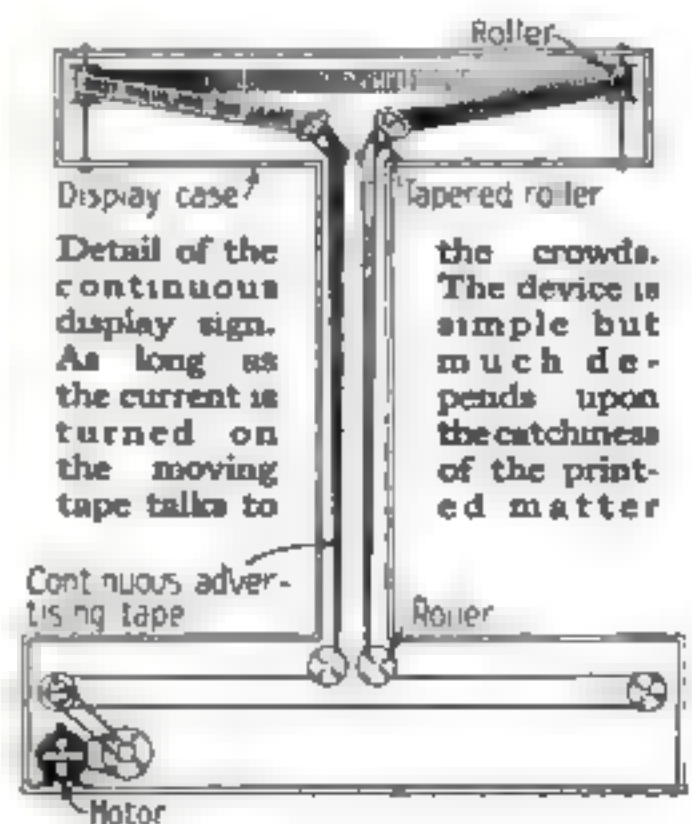
Above all things a new silk must lend itself to the making of clothes. A silk manufacturer hit upon the happy idea of dressing dolls in the new fabrics to get the effect which the silks would produce if made up into gowns.

The silk is woven and dyed. If it has a pattern, a piece of it in plain color is used for the doll's dress. Then the large pattern is carefully drawn to scale and painted on the silk to be used for the doll's dress. In this manner the doll is made to represent a fashion-

able lady clad in the newest silks. Although the doll is only twelve inches tall the proportions are so perfect that the silk can be studied and passed upon by the examiners exactly as though it were made up into a woman's garment.



A silk manufacturer's doll. He does not play with her. She is gowned in the latest silks to try their effect



Housekeeping Made Easy



An adjustable handle for the dustpan. It can be used short and with a side-grasp, or with a long wooden handle



A special paper bag into which the table refuse may be scraped. It keeps the garbage can clean and odorless



The hair on this jokester's head is composed of matches. His mouth will hold the match box



The oil stove in the center picture above has a reversible glass reservoir to measure the oil



You may cook two things at the same time on this miniature electric stove



A kitchen table converted into a sewing machine by setting the machine head and treadle

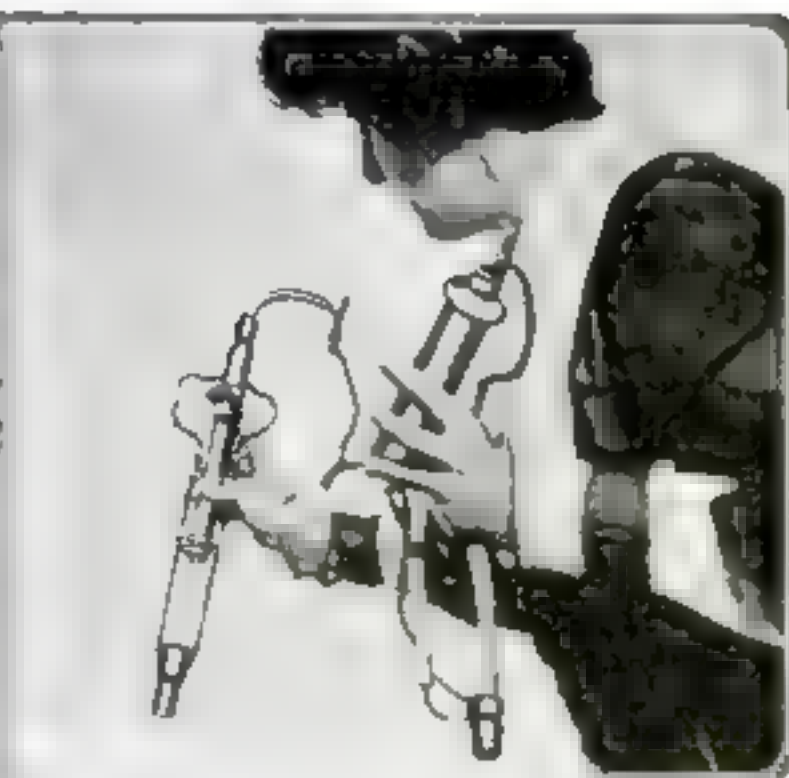


An umbrella bag with a pocket for rubbers

Housekeeping Made Easy



This drainer in the bottom of the boiler makes it possible to lift the clothes out without splashing or danger of a scald



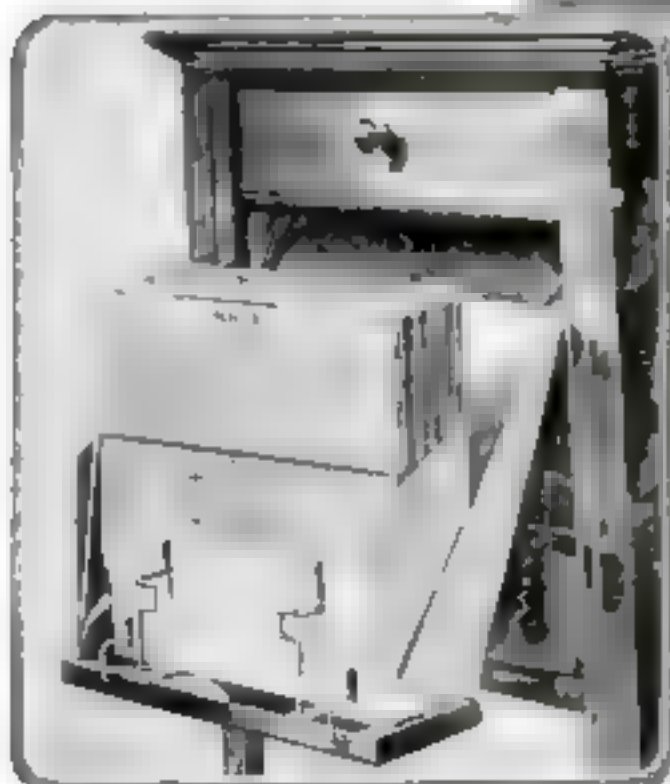
An electric water heater with a controller to regulate the strength of the current according to the amount of water



With this metal fruit jar cap and its reciprocating rack engaging a pinion on the end of a shaft carrying a whipper, cream can be whipped in the jar



By drawing this scraper across the prints of butter, little cone-shaped pats are formed



A new card index cabinet. When closed it is a flat wall-drawer

A hinged brush which clamps over the clothes-line and cleans it



This device sifts the ashes and throws the unburned cinders back into the pail

Catapulting Seaplanes from U-Boats

Solving the difficult problem of launching a flying machine over rough water



A little elevated railway is built on the after deck of the ship. On the track runs a little car which carries the seaplane, projecting it into the air when the end of the track is reached

LONG before the engagements of the German and British fleets in the North Sea focused the eyes of the world upon the possibilities of scouting in the air, the officers of our Navy had foreseen the part that the flying machine would play in battle. But they were prevented from carrying their vision into reality by the difficulties of launching a seaplane. When the water is rough a flying boat is so battered about by the waves that it is unable to make that preliminary run without which it cannot fly. In the earliest experiments a platform was built over the decks of one of our warships, and a flying machine actually succeeded not only in launching itself from that platform, but even in alighting upon it. But a platform is obviously an encumbrance. When a ship is to be cleared for action it is in the way.

For some years Capt. Washington I. Chambers of our Navy has been working on this launching problem. He has at last devised an ingenious catapult with which some of our ships are provided and which seems to meet the technical requirements of those who must fight on the seas.

Capt. Chambers' launching device is in reality a little elevated railway built on the after-deck. On the track runs a little car

which carries the seaplane. The car shoots forward, carrying with it the seaplane. When the end of the track is reached, the seaplane is projected into the air, its motor having been started before the run. The car returns automatically to the starting position after having struck a buffer.

What propels the car? Not the screw of the flying machine, as might be supposed at first blush, but a simple piece of machinery consisting of cable, tackle, and a compressed-air cylinder. One end of the wire cable is attached to the car and the other to the piston of the cylinder. The tackle in between serves to magnify to 60 feet the push of the piston, which is about $4\frac{1}{2}$ feet. The function of the tackle is not unlike that performed by the pulleys that hoist a safe from the sidewalk to a fourth or fifth story window. By the time the seaplane has reached the end of the track, it will have a speed of at least forty miles an hour, which, in normal conditions, keeps it aloft if the propellers are in motion. Of course, the seaplane must be automatically unlatched from the car.

The elevated structure upon which the track is carried, is so designed that it can be removed very quickly when the ship is to be cleared for action.

Touring the Country in a House-Mobile

How a Ford touring car was transformed into an attractive living apartment



The equipment includes a small printing outfit with which the travelers earn pocket money on their journey

The quarters are small but not cramped. The tables and chairs and other furniture pieces fold up and are stored away when not in use

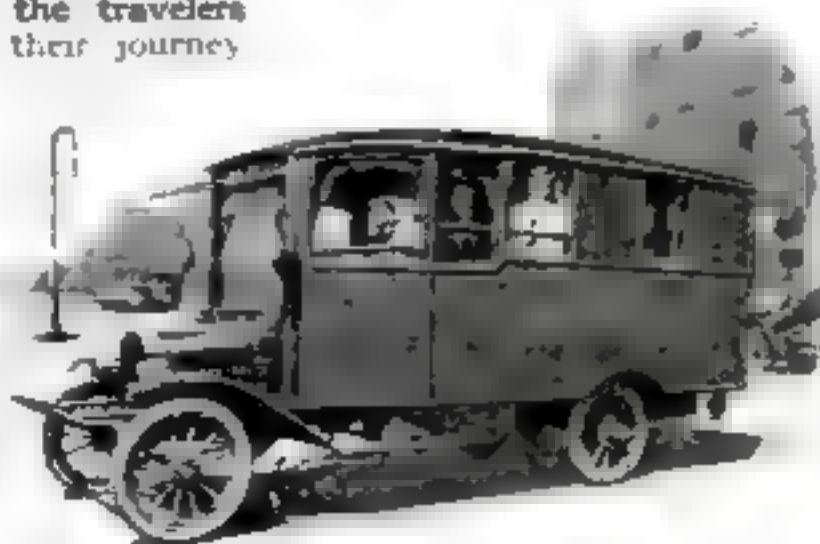
They followed the Old National Trail to Chicago and the Lincoln Highway to New York where they are now taking a rest

The house-mobile was originally a Ford Touring car with truck attachment and is geared to 15 miles an hour. It weighs 5000 pounds. The interior has been covered with wall board. The driving seat makes

up into a bed; a water tank furnishes running water; there is a tiny kitchenette, a choice of gas or electric lights, a long case of books, a writing table and a victrola with many records, a folding table and chairs.

As the weather grows colder, Mr. and Mrs. Robins are going on to Florida.

IN May, 1916, Mr. and Mrs. A. W. Robins started from San Francisco, California, in a house-motor-truck, and they have been on the road ever since, stopping a few days here and a few days there.



From coast to coast and from Canada to the Gulf they will travel in their house-mobile



The pig with his individual pen can rove all over the farm but he can't root under fences

This Little Pig Went to Market—and Carried Its Pen Along

THE photograph above shows the construction of a pen made for the individual use of a pig afflicted with Wanderlust. It was effective in keeping the pig out of the enclosed places and yet left him free to wander anywhere he pleased. The rub came when he tried to get under a fence or into the chicken coops. It is the invention of S. L. and J. A. Hirst, of Arkansas Pass, Tex.

A Portable Alfalfa Mill Grinds Hay for the Allies' Cavalry

BALED alfalfa hay is shipped from California to all parts of the world where cattle or horses are fed. Yet this, added to the immense home consumption, could not use up all of the tremendous crop.

The problem was solved a few years ago by the invention of a machine, now proved successful, which travels from field to field and converts alfalfa hay into alfalfa meal, using stems and all. It is known as the portable mill.

The meal, itself, is not a new product. Alfalfa meal has been made for years in

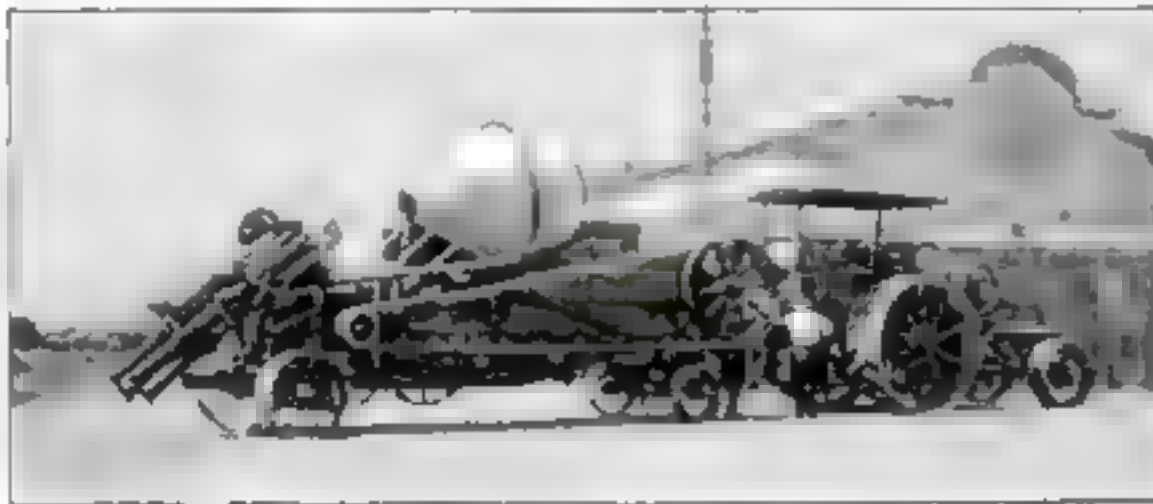
stationary mills; but the labor and cost of hauling, and the loss of fine leafage in handling, held back the industry. The portable mill did away with all that.

The mill can be operated with steam or electricity. A traction engine is preferred because after a job is done, the engine can hook on to the mill and haul it to the next field. Three or four horses can haul it, where no engine is used. Two men can fold the machine up for traveling and can set it up again in twenty minutes. When folded, it is compact enough to pass beneath telephone lines or trees, and to pass over irrigation ditches, etc.

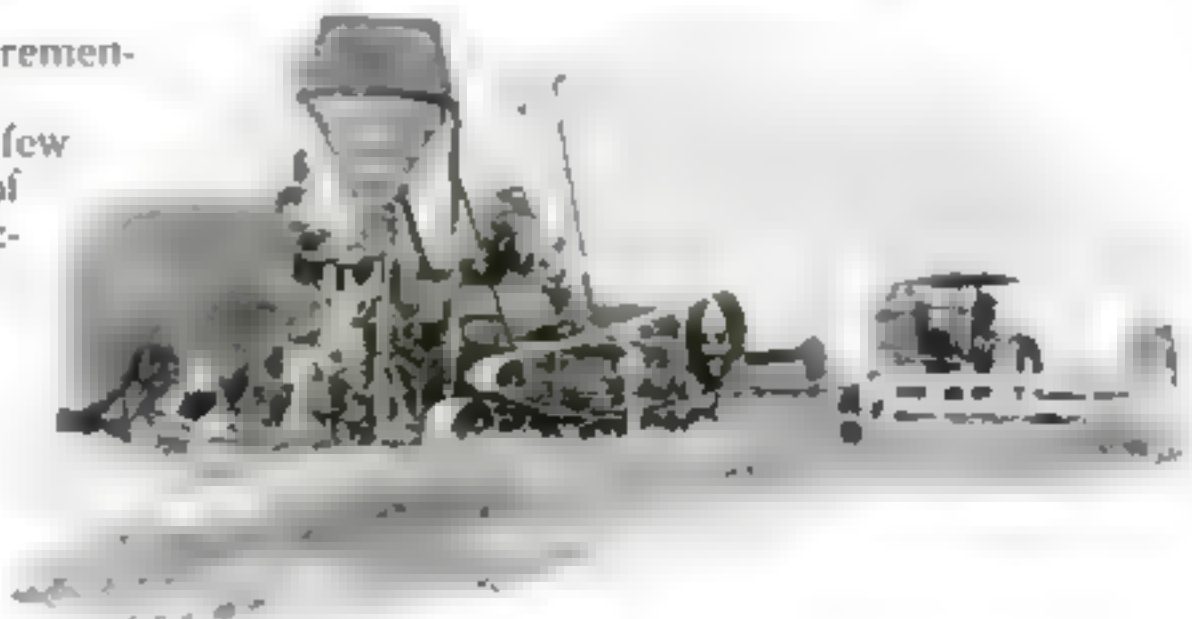
The mill can be adjusted to sack the meal, to blow it into silos, into barns, or on the ground. An engineer, stacker, feeder, sacker, sack sewer, water boy, and horse fork boy are required to run the outfit.

Alfalfa meal is a valuable concentrate alone, but it is usually fed in conjunction with coarser ground feeds. When desired, the mill can be adjusted to mix corn or oat hay or other mixture.

The meal is shipped at the grain rate, which is from one-third to one-fourth less than the hay rate. A ton of loose alfalfa will occupy approximately 500 cubic feet; baled alfalfa, from 215 to 225 cubic feet. The meal takes up only 100 cubic feet.



The portable alfalfa mill. It is drawn by engine power from field to field and converts the hay into meal at a fraction of the usual mulling cost



Identification Rings and Neck Tags for Our Soldiers

WIVES, mothers, doting relatives and best girls are busy these days getting things together to give to the boys who are going to war. A very popular and a very useful gift is a silver identification ring. These rings are so made that the wearer may have his monogram engraved on the outside and his name and military connection on the inside. While the soldier boy has his hand, this is an excellent means of identification.

Uncle Sam has provided a means for identifying his soldiers which never can fail. A small metal tag is inscribed with the soldier's name, rank, company and regiment. This is suspended on a tape which the soldier wears around his neck.

The Navy has arranged for the identification of all Navy officers by means of finger prints and metal tags. A reproduction of the finger print of the right index finger will be etched on the metal tags. A record of the finger prints will be kept in the bureau of navigation.

These records and means of personal identification will serve to facilitate communication between the soldiers and the folks at home, as well as to complete the reports of the newspapers and their lists of casualties after a great battle or important engagement at the front.

Show You the Rug at the Bottom of the Pile? Why, Certainly

FORTUNATE, indeed, is the rug salesman who has the knack of selecting the most desirable and easily sold rugs for the top of the pile in his display! Usually, it is the rug at the bottom of the pile, or at least one below the center, that

appeals most of all to the prospective purchaser. And to make a sale he must smilingly get it out so that its beauty can be enlarged upon.

But getting it out—there's the rub. However, relief is in sight. A rug extractor has been invented and marketed which does the work with magical ease, eliminating the back-bending and tugging.

The device is very simple in construction. It consists merely of a long tube which the salesman attaches to the designated rug and

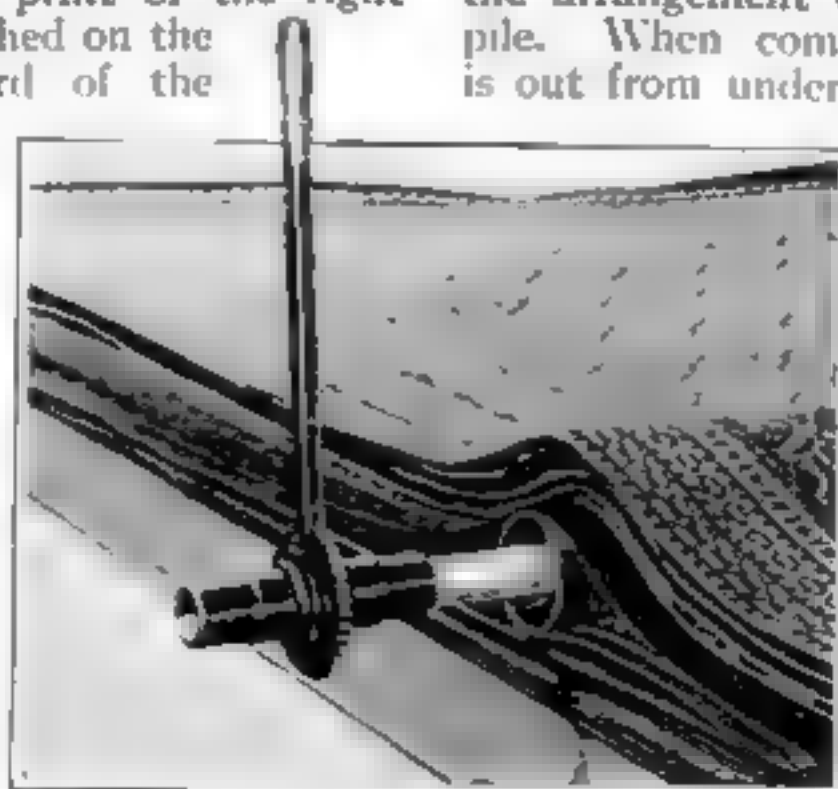
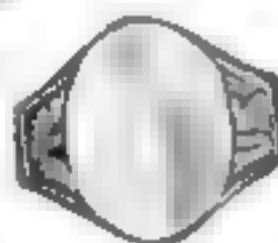
which rolls up the rug by means of a ratchet and lever. The rolling-up operation is accomplished without disturbing the arrangement of the other rugs in the pile. When completely rolled, the rug is out from under the pile. It can then

be unrolled and spread out on the top. Only a minute is required for the entire rolling and unrolling operation.

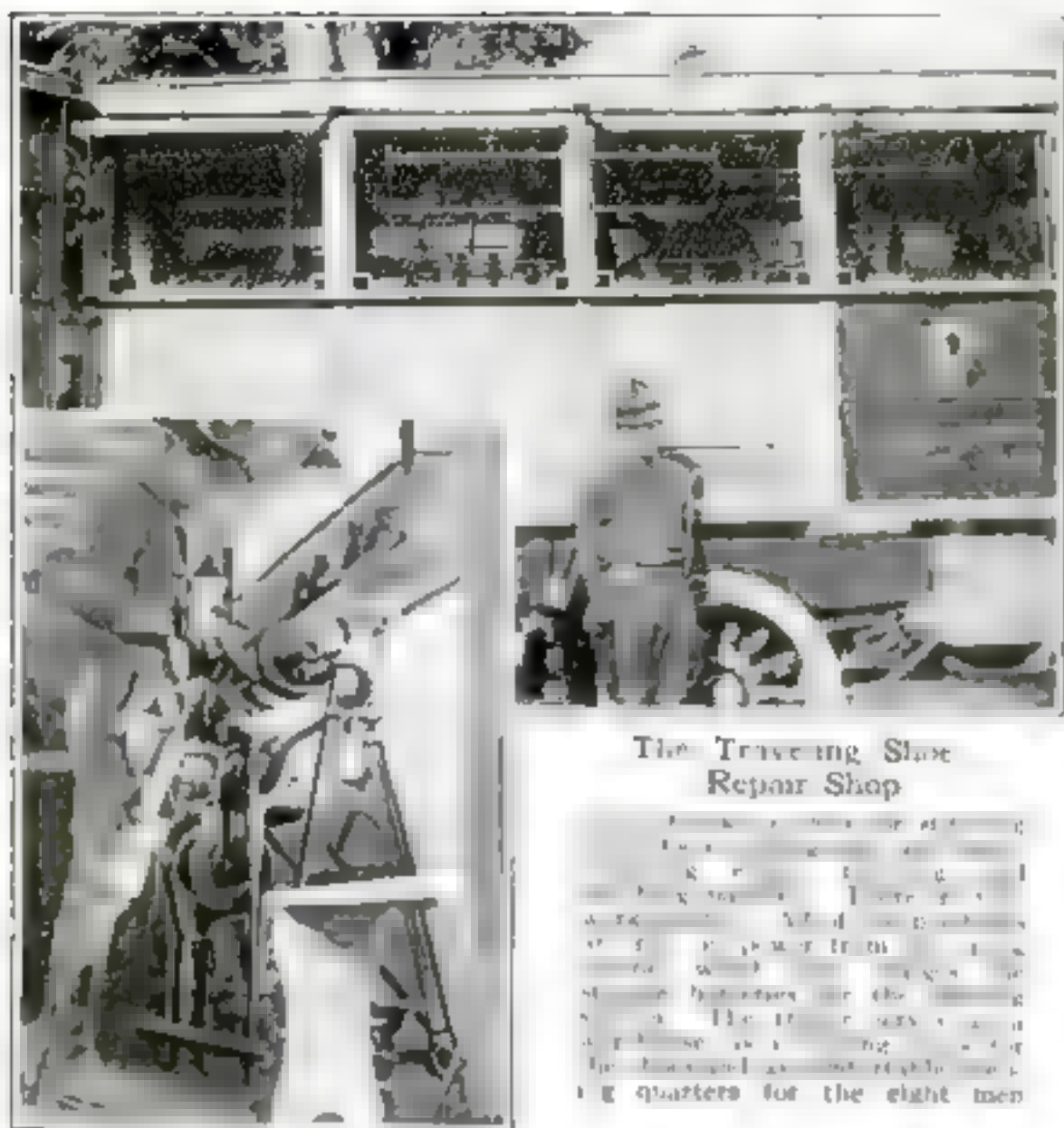
The salesman can operate it alone in an emergency, but two men, one at each end of the tube, are usually required to get it started. Once started, the rug is rolled without further trouble by the man originally conducting the sale.



The identification tags and rings for our boys of the Army and Navy



The rug is rolled on the tube by means of a ratchet and lever. Then it is extracted and unrolled on top of the pile for display



The Traveling Shoe Repair Shop

What Does an Army Need Most?

"Shoes," said Napoleon

THE first traveling shoe-repairing equipment to be used by any of the armies of the world has been presented to the Massachusetts' troops of the United States Army by the United Shoe Machinery Company, of Boston, Mass. The equipment, which consists of a motor-truck and a trailer, is fitted with special shoe machinery to permit a crew of six men to repair from four hundred to six hundred pairs of shoes a day. It is designed to go forward with the army as far as practicable and repair the shoes of the troops on the spot and thus eliminate the cost of maintaining huge shops back of the lines and the cost of getting the shoes there and back again to the front line trenches after they have been repaired.

The quick machine

outfit to be withdrawn to safety quickly.

The motor truck part of the outfit carries all of the shoe-repairing machinery and the trailer serves as a warehouse, as a clearing house and as sleeping quarters.

A Pouch Which Will Not Spill Your Tobacco



The spout at the bottom of the pouch serves as a trough down which the tobacco slides directly into the bowl of the pipe

THE combined tobacco pouch and pipe filler illustrated at left will prevent you losing even a little of your precious "fillings."

The pouch has a spout at the bottom which serves as a trough, and then doubles up again and fastens over the pouch opening. When the pouch is opened and slightly squeezed the tobacco slides down the trough into the pipe.

This pouch serves equally well, of course, for making cigarettes. In either case the operations are simplified and you will make a neat job of the filling.

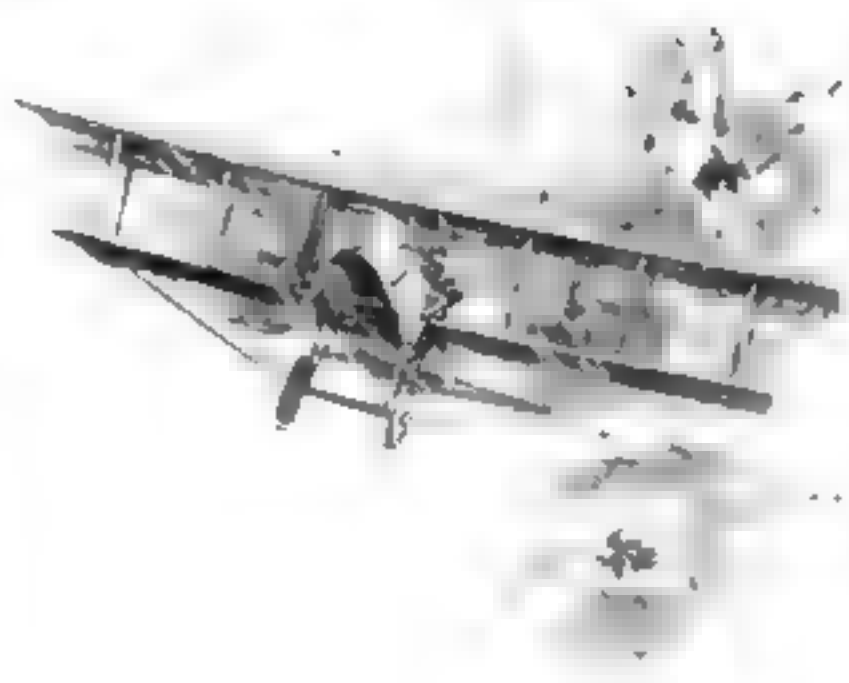
Directing Big Gun Fire from Airplanes

The man in the air, circling between home battery and enemy target, gives the signals to fire

RÉGLAGE," or fire-control, is the most difficult and the most dangerous work performed by the Flying Corps at the front. The machines used are large and unwieldy, built to carry the weight of two men and all sorts of equipment. They are fairly fast, but their spread of wing is so large that it is almost impossible for them to make a turn quickly when attacked. They are armed with a machine gun, it is true, but they are always at a great disadvantage in the presence of an enemy fighting-machine which can outmaneuver them at every turn. In a very interesting little volume entitled "With the French Flying Corps" and published by Charles Scribner's Sons, the author, Carroll Dana Winslow says:

The first duty to which I was assigned was "réglage," and this, I found, involves many complications. The chief source of trouble usually is the wireless apparatus, which has to be maintained in perfect working order. Before leaving the home field you usually circle over it, while your observer tests his sending apparatus. The receiving operator then answers by visual signals. Usually these are large white sheets laid on the ground in different formations, which have a prearranged meaning. When the radio is found to be in perfect order you are off to the battery you have been ordered to co-operate with. By wireless your observer then reports to the battery commander, and receives his orders by means of the same visual signals. You then head in the direction indicated to you before leaving, and, hovering over the position to be bombarded, the observer signals back "fire." The moment the shells have landed you turn quickly about and inform the artillery just how many metres their fire was long, short, or to the right or left. Your message is once more answered with the sheets. Again you fly back toward the enemy's position, circling in this way backward and forward between the battery and the target until the réglage is completed. Naturally every care must be taken not to disclose the position of your own guns to the enemy, or retaliation—"strafe," the English call it—follows. Sometimes it is the battery which interrupts the work with the signal, "Avion ennemi," when the fire instantly ceases until the German airplane has disappeared or been driven off.

With such occasional interruptions the work continues until the observer can send back the signal "fire correct," which is generally answered by the "sheet signal"



with the information that the machine may return home. Until this dismissal occurs, however, the ground below wholly engrosses the attention of the observer. The pilot is forced to keep a close watch for German fighting-machines so as not to be caught unawares by one of them. This is often a very trying task, as the models of some of the French and German airplanes are so very much alike that they cannot be distinguished until they are within range.

The novelty of airplane fire-control is thus dwelt upon:

It is a curious fact that in the first months of the war many artillery officers refused to follow the directions of their arial observers. A colonel of artillery who has been firing big guns all his life cannot be blamed for not thinking that a young observation officer and a mere aviator know enough about the work of batteries to tell him where his shells are falling. Orders, consequently, had to be issued placing the artillery absolutely under the direction of the observers and calling upon the pilots to report any case where a battery refused to be guided by the signals it received. That put an end to the trouble.

The sensations of the pilot are then described.

At first I felt a strong aversion to flying over batteries in action. You are bound to get in close proximity to the trajectory of the shells, and the constant sensation and sound of the passing projectiles is none too pleasant. You get them both coming and going, and, no matter which you are trying to avoid, you are always taking a chance with the other. It is a question of choosing between the devil and the deep sea, with the devil constantly stepping into your path.

The December issue of Popular Science Monthly will be on sale on all news-stands Saturday, November tenth (West of the Rocky Mountains, November twenty-fifth).



French Official Photo

The street carts of the sanitary service now in use in Paris are hauled by teams of dogs

The Horses Have Gone to the Front, So Paris Drives Dogs

NOT only are large numbers of dogs in training for Red Cross rescue work on the battlefields, but in the industrial world also, dogs are being utilized, especially in Paris. There the city officials have assigned to the dogs the work of the horses of the street cleaning and sanitary departments. They are driven in teams, and draw small carts, somewhat larger than ordinary handcarts.

Into these carts the collected refuse is placed in covered cans, and an oilcloth covering is fitted over cans and cart. The whiffletree is attached to the cart in such a manner that the dogs may lie down to rest without inconvenience while the carts are being loaded or unloaded.

The dogs make their rounds in as good time as the horses did formerly. The carts are smaller than the old horse carts; but there are more of them. The upkeep of the dog-teams is considerably less expensive than that of the horses.

We Are Now Getting Natural Indigo From Michigan

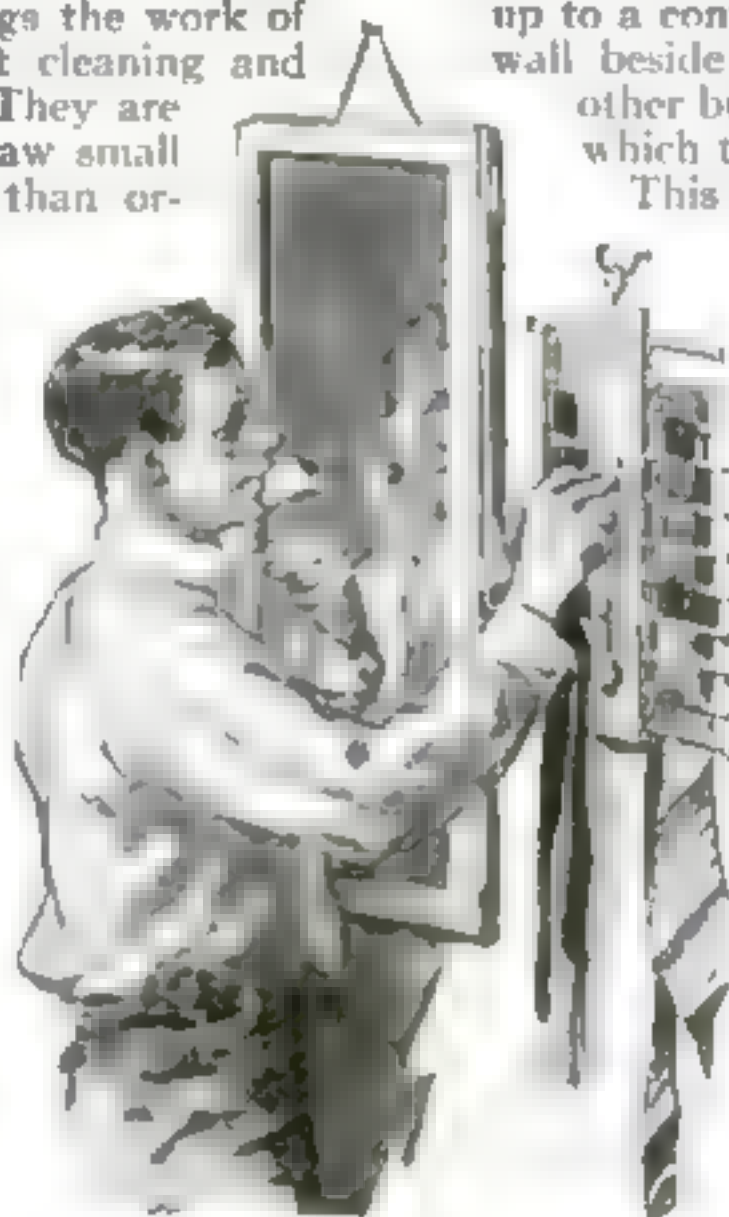
ADVICES from Midland, Michigan, tell us of the first production of indigo from coal tar in the United States. One thousand pounds of 20% paste are produced daily despite the fact that in the last tariff bill the duty on dyestuffs was removed from indigo. The annual consumption of indigo in normal times is in the neighborhood of 10,000,000 pounds. By 1912, the German makers of the coal tar indigo, which is chemically the same as the product of the tropical indigo plants, had driven the natural product from the world's markets. The artificial is considered better and more reliable than the natural dye.—ELLWOOD HENDRICK.

Where's That Collar Button?—Why, In the Button Rack, of Course

NO longer need the bachelor fume and the benedict distress the ears of his household over a lost collar button. If he is a really up-to-the-minute specimen of American manhood he will simply reach up to a convenient slab hanging on the wall beside his chiffonier and get another button out of the button-rack which the slab carries.

This little temper-saver is a combination tie-rack, button-holder and pincushion. Its construction is simplicity exemplified. A central slab of wood has a buttonhole groove attached to it into which six or more collar buttons slide and are held ready for use. At the bottom of the wooden slab a pincushion is glued on securely. Into this, stickpins may be thrust. Finally, at the sides of the center slab are arms upon which an assortment of ties may be kept in plain view so that a choice may be made readily.

The device might reasonably be called the silent and ever-ready valet.



The combination tie-rack, collar-button-holder and pincushion which hangs on the wall beside the chiffonier

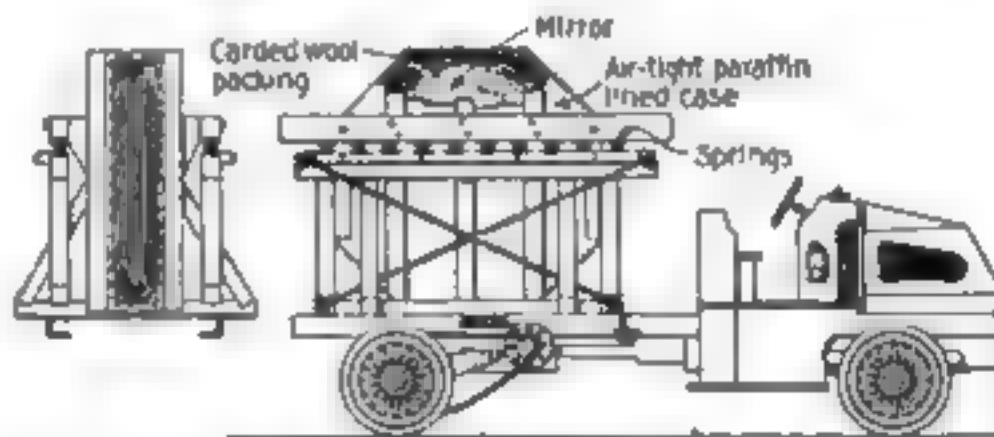
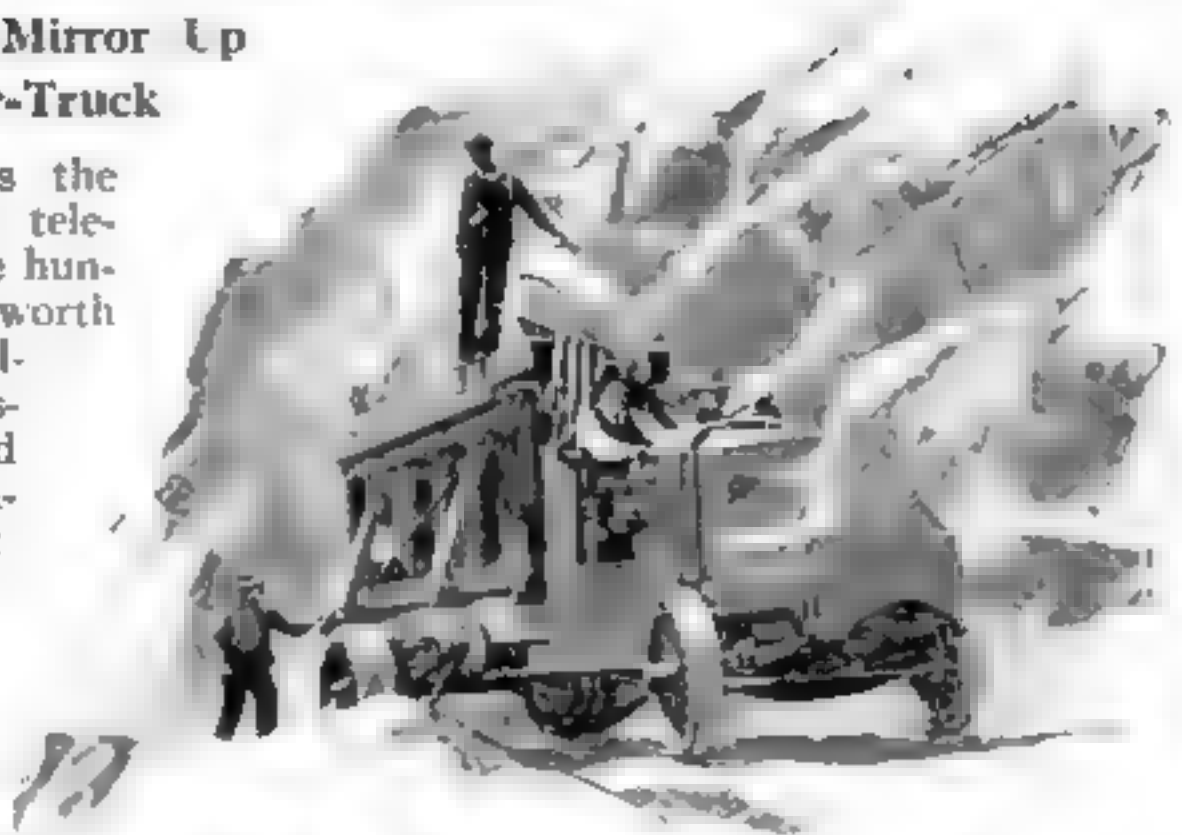
Transporting a Precious Mirror Up a Mountain by Motor-Truck

THE hope of astronomers the world over, the largest telescopic mirror in existence, one hundred inches in diameter and worth over one hundred thousand dollars, was recently safely transported up the winding nine and one-half mile trail from Pasadena, Cal., to the top of Mount Wilson, by motor-truck. It is said to be the most expensive load ever carried by a motor-truck and its safe arrival at the top, one of the greatest feats contributed to science by the motor-truck.

The mirror is priceless, since it cannot now be duplicated, and is ground so accurately that its surface changes from the heat of a man's body three feet away. For this reason, it was carried on the truck in a special air-tight box lined with paraffin, with layers of carded wool to protect it against breakage and to maintain it at an even-temperature. In turn, the box itself was mounted on powerful but delicately-adjusted coil springs to prevent any possibility of breakage due to the uneven road surface up the steep trail. The trail has fifty turns in it with an uphill grade of not less than twelve per cent at any point.

A special brakeman on the truck did nothing but apply the brakes so that the driver might give all his attention to steering.

Another man on the top of the truck, gave his entire attention to the coverings and strappings around the precious load. Still another walked behind the truck in order to observe the least tendency of any



The truck in which the 100,000-dollar mirror was carried up the mountain. At left is shown the details of the construction

part of the load to slip or become disarranged. The trip was made slowly, so that the man walking behind had no difficulty in keeping up with the truck.

Keeping Your Pencil Where You Can Find It

STENOGRAPHERS and scribes of every description will appreciate this new pencil-holder, invented by George W.

Paulus, of Grand Rapids, Mich., which can be attached to any kind of a note-book. It is in the form of an open-sided cylinder, of a diameter about equal to that of an ordinary pencil. At the back of the cylinder is a bead extending the full length of the device. This serves the double purpose of strengthening the holder and of providing a means for affixing a stiff piece of paper to it. The paper is used to glue the pencil-holding device to the cover of the pad.



The paper strips are fastened one on each side of the cover to keep the holder in place



Submerging billets of wood. The water displaced and forced out into the graduated pail will be equal to the solid contents of the wood

Here Is the Xylometer. It Measures the Waste in Wood Products

THERE has always been a large amount of waste in converting a tree into lumber and other products. The first logical step in the reduction of this waste is an accurate determination of the amount of waste and a careful study of the process of manufacture and remanufacture. A xylometer offers the most practical means of determining the percentage of waste and may be of inestimable value to the forester, woodsman and mill operator attempting a closer utilization of forest products.

The xylometer is an instrument which is not well-known in America but which has been in use for years in European countries.

The type here shown was improvised from an ordinary round-end galvanized steel storage tank by removing a number of

unnecessary top cross-braces and attaching an overflow spout near the top of one end. The operation of this instrument is very simple, being based upon the principle that a submerged body displaces a volume of water equal to its own solid contents. The tank is filled with water to the overflow spout; then the wood material to be measured is submerged. The displaced volume of water escaping through the opening or overflow represents the exact volume of the submerged material.

Some of the results concerning wood waste secured by the use of this instrument are almost incredible. For example: a white pine tree, which in its original condition comprised 25.05 cubic feet of wood and bark, was converted into shingles. It yielded 603 shingles (4 x 21 inches) which displaced 11.86 cubic feet of water, showing that only 47.3 per cent of the wood originally in the tree remained in the finished product. The exact percentage of waste would be difficult, if not impossible, to obtain by other means.—J. S. ILLICK.

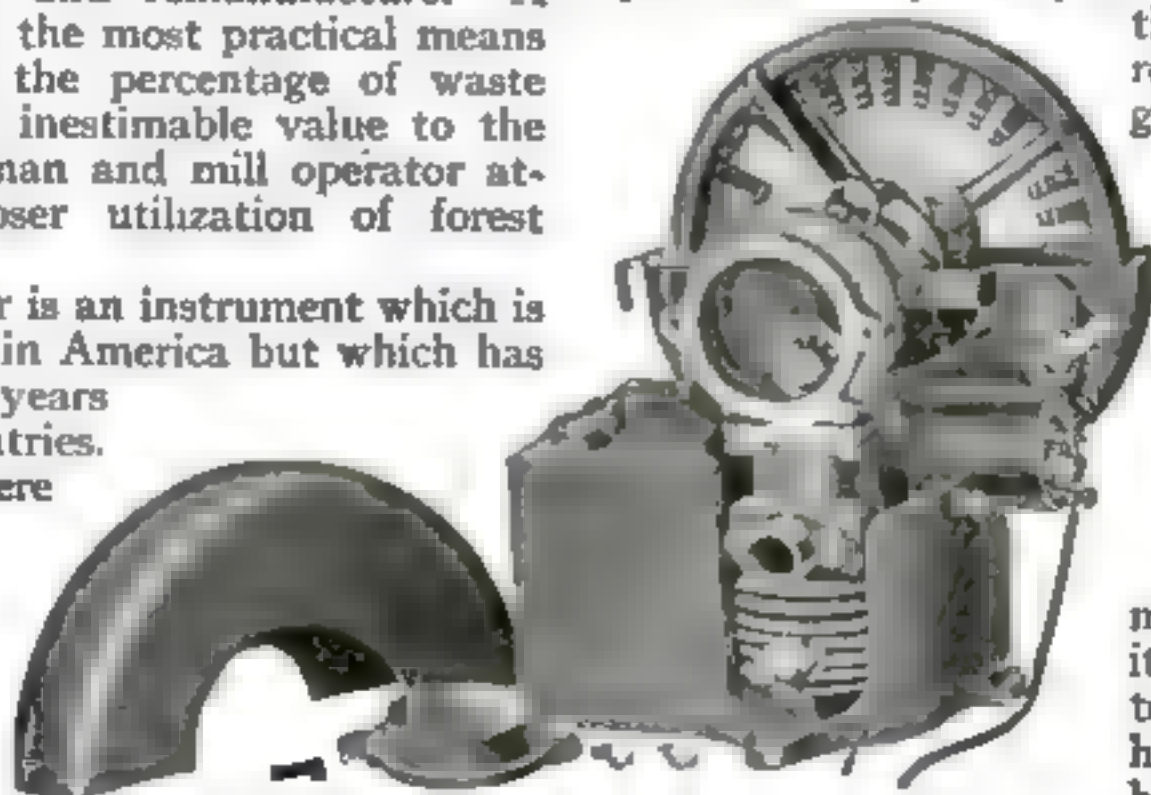
The Simplified Gasoline Engine. It's the Hired Girl of the Country

THIS miniature motor is the housewife's faithful laundress, churning, etc. It can be operated with as much success by a child as by an adult. One turn of the light flywheel and the engine starts off. By simply turning the thumbscrew over the main bearing, its speed is adjusted.

The cylinder of the motor is inverted. This allows the gasoline to flow from its tank directly into contact with the electric spark caused by the spark coil of the ignition system. The

result is that some gas will immediately explode and the engine can be quickly started even in the coldest weather. The inversion of the cylinder,

moreover, makes it a simple matter to enclose its hot end in an iron housing, out of the way of the children's fingers.



The automatic engine. Its speed is adjustable. ■■■ the cooling is automatic, the flywheel whirling air into the engine base like a centrifugal fan

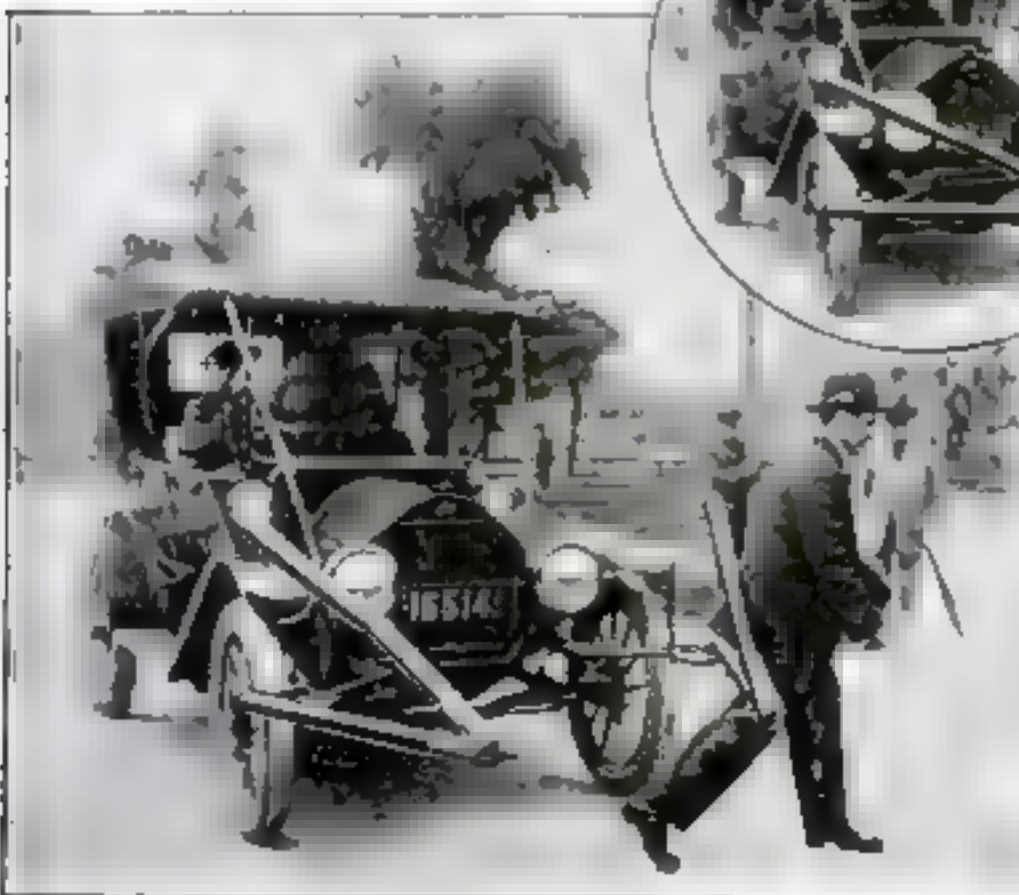
Throwing You Out of the Automobile's Way

IF your car is equipped with the new life-saving device invented by Jos. M. Crichrion, of Monterey, California, you need not fear that you will injure the careless pedestrian who gets in your path. You may knock him down, but you can not run over him.

This safety device consists of two arms which are attached to the front of the machine. When these arms come into contact with anything, they are released automatically and fling the object which they encounter out of the path of the machine. The arms are padded so as to be easy on the pedestrian.

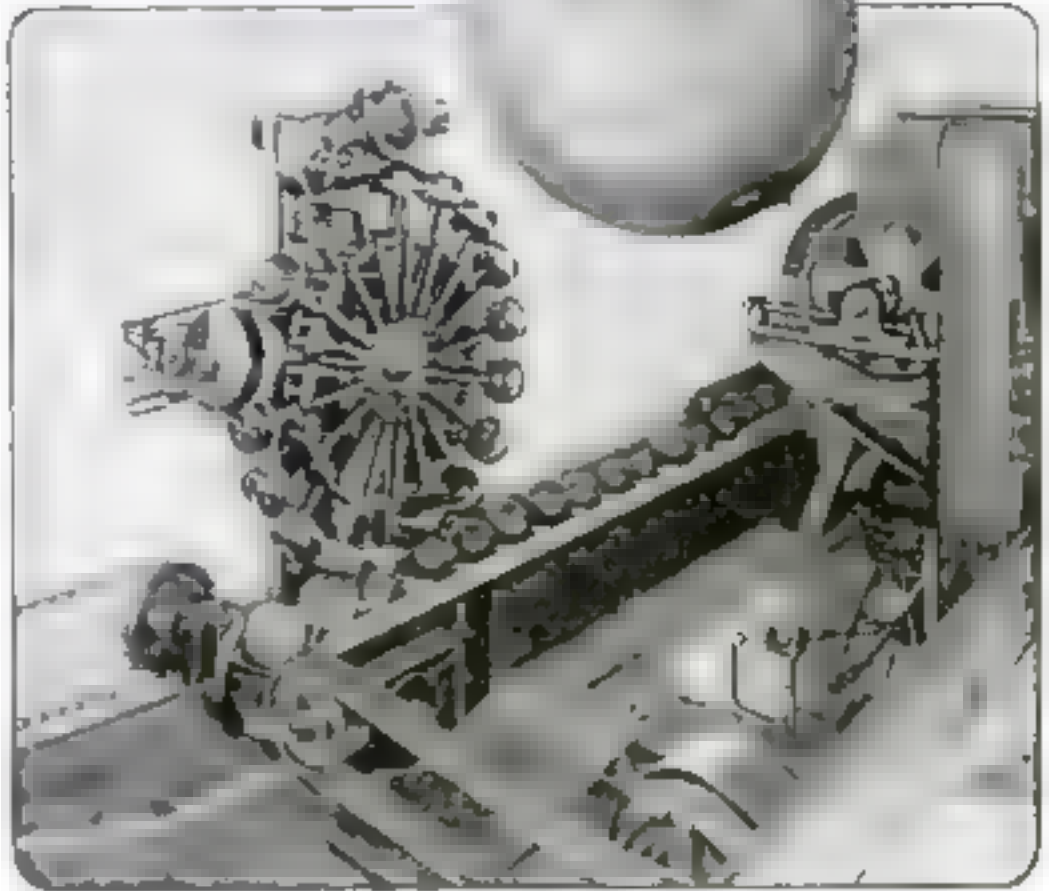
This invention has been tried out in California and is said to be very successful. A car traveling at the rate of twenty-five miles an hour ran into a man for a test. The man was not hurt. Since he knew what was coming he was not even shocked.

We don't think that the four million automobile owners in the country will scramble over one another in their efforts to buy this safety device. It may be operative and useful—but look at it! Imagine the arms protruding from the latest type of trim roadster!



© Int. Film Serv.

Two arms attached to the front of the automobile are released automatically to clear the car's path



The marking machines simply melt the natural wax on the outer skin of the fruit and make the inked imprint on the second skin. This does not injure the fruit

A Machine Which Stamps Oranges with a Trademark

A LONG-STANDING problem in the fruit merchandising business may soon be solved by a patented marking machine invented by Frank Ahlburg, of San Francisco, which stamps the trade name on the fruit before it is shipped to the dealer.

The marking machine consists of a revolving wheel carrying the marking dies across the fruit which passes beneath it in an endless conveyor. The eighteen plungers on the wheel are so arranged that they have a play of two and one-half inches toward the center of the wheel, this being the extreme range of marketable oranges or lemons. Pressure for the marking is furnished partly by the weight of one and one-half pounds and an added spring pressure. The plunger head consists of two parts, the electric heating element lying between them. Current is supplied from a set of brass rings on the axis of the wheel, by means of sliding contact rods. Each of the eighteen dies is inked at every revolution of the wheel.

How Italian Sharpshooters Guard Venice from Aerial Attack

EVERY little while an Austrian airplane attempts to make a raid on Venice. As soon as an enemy aircraft is sighted the sharpshooters of the Italian army stationed at Venice are assembled for a concentrated attack on the airman.

Pavilions for the crack shots have been set up at points of vantage all over the city. These are provided with beams which are positioned just over the heads of the men and serve as rifle rests which make aiming much more certain than it would be if the soldier simply rested his rifle against his shoulder.

Frequently as many as thirty of the best shots in Venice are gathered together in one of these little pavilions. The invader invariably retreats or comes to grief.

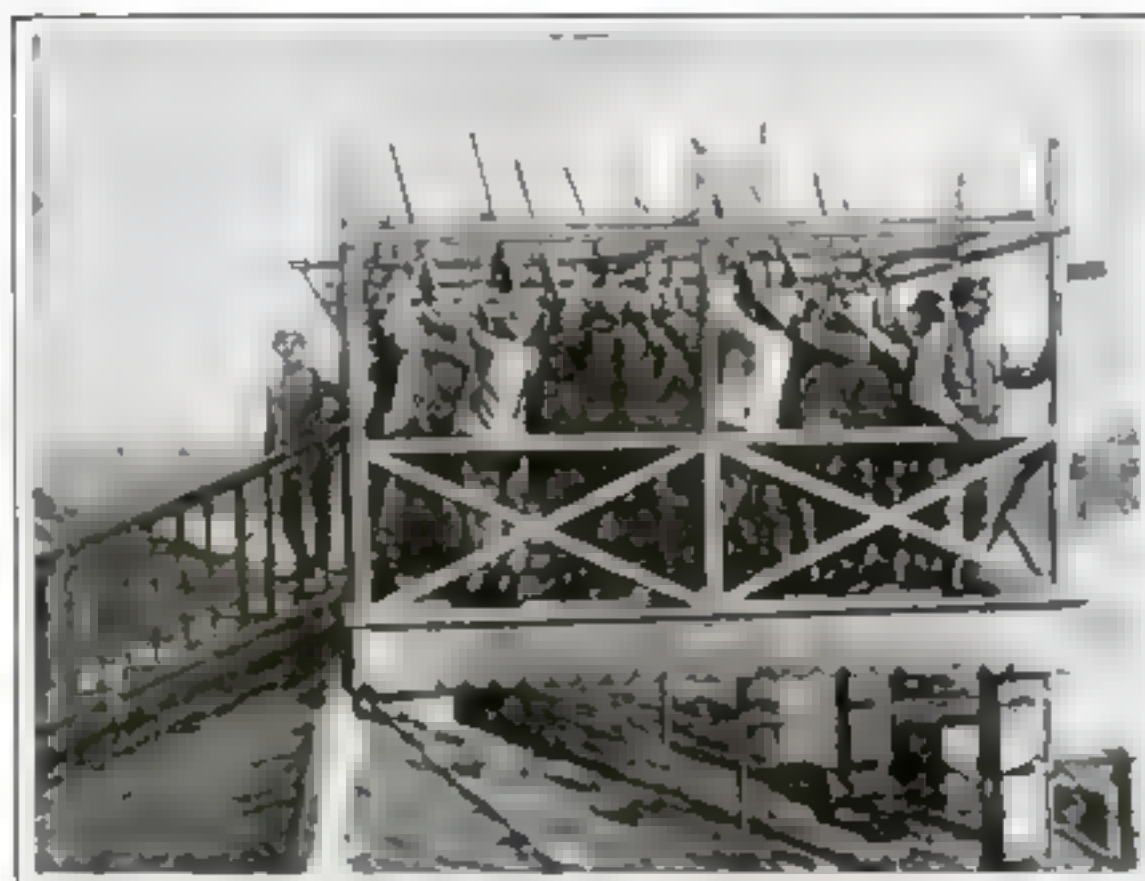
Prevent Typhoid. Sterilize Your Drinking Water!

IMPURE drinking water means typhoid. It is therefore wise to sterilize all water which may possibly be contaminated. Ordinary boiling will help, but a much more certain treatment is the following: Take a level teaspoonful of pure chloride of lime and mix it with a little of the water in a cup. When a thin paste has been made, add another teaspoonful of the lime, and thin that down with water also. When nearly a cupful of the lime and water has been made, three more cupfuls of water should be added slowly. After the paste has become well mixed and no lumps are to be found, the solution should be placed in a dark bottle and tightly corked.

A teaspoonful of this solution should be added to every two gallons of the water to be drunk. After being well mixed in with the water, it should be allowed to stand for about twenty minutes. During this time, the lime will be giving

off its chlorine and this chlorine will kill any germs that may be present. The bottle of sterilizing solution will keep its purifying qualities for a week.

It is a good plan to prepare it in rather small quantities of not more than one week's supply at a time.



Italian sharpshooters attacking the aerial invaders. The best crack shots of the army are always employed

A Homemade Hand Plow Built from an Old Bicycle

A FARMER out in California had no hand plow so he proceeded to improvise one. The body of the plow he made is an old bicycle frame. The bicycle handlebar was taken off, turned backward and set solidly in the frame. The wheel was taken from a large gate valve. The plow share is attached to the frame by a U-bolt.

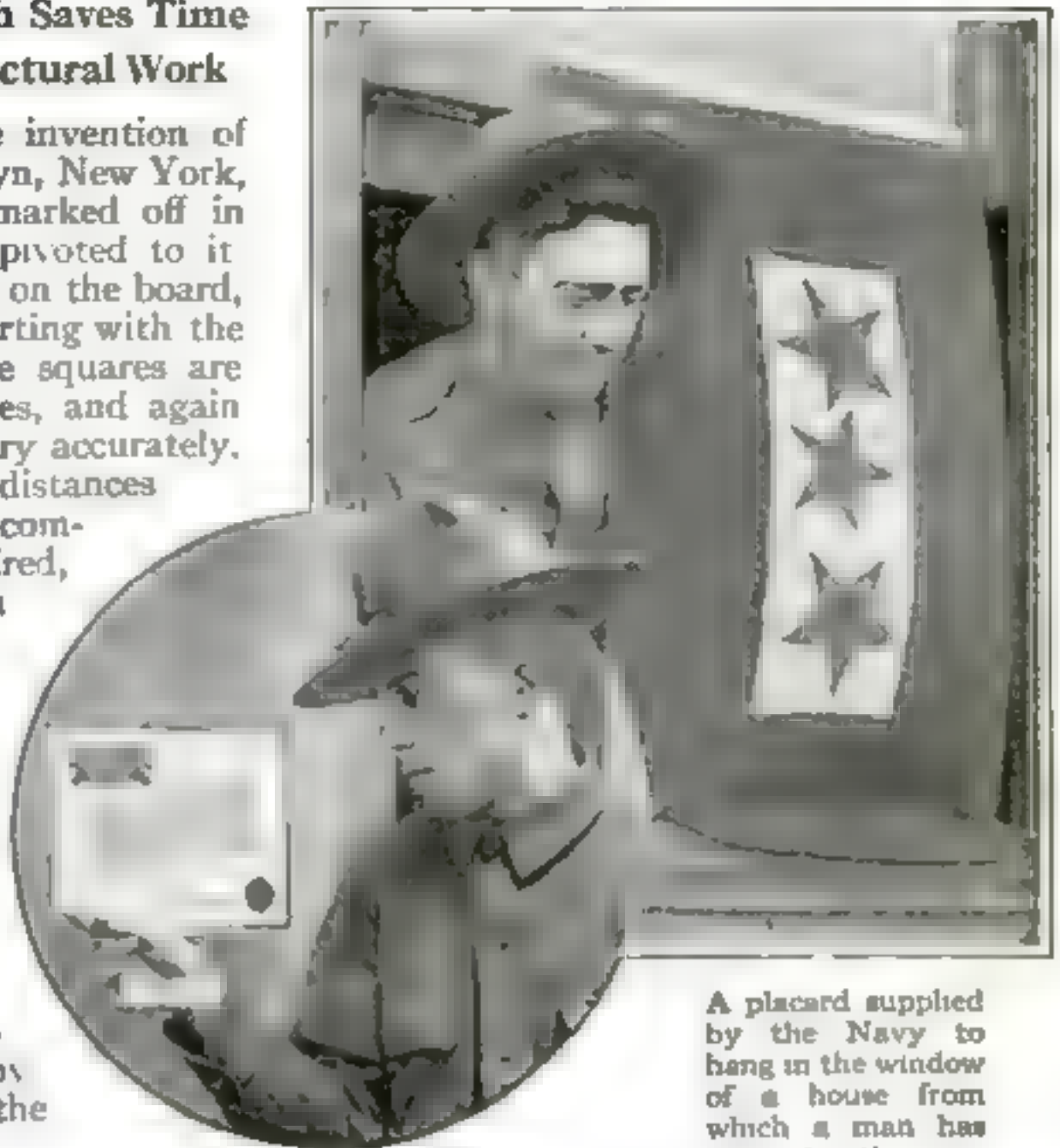


The frame of an old bicycle with handlebars turned backwards was used for this hand plow

A Measuring Board Which Saves Time and Calculations on Structural Work

A BOARD which is the invention of Otto Nielsen, of Brooklyn, New York, contains two large scales, marked off in feet and inches, which are pivoted to it. One-foot squares are marked on the board, and these are numbered, starting with the point of pivot. These large squares are subdivided into square inches, and again into square eighth-inches, very accurately. If the vertical and horizontal distances between any two points on a complex slanting member are desired, it is necessary only to turn the pivoted scale to the corresponding angle shown by the board protractor. The required distances are obtainable at once by reading the squares up to the point on the pivoted scale which corresponds to the distance between the two points.

Distances intricate to compute can be readily found by laying off the outlines of the structure on the board.

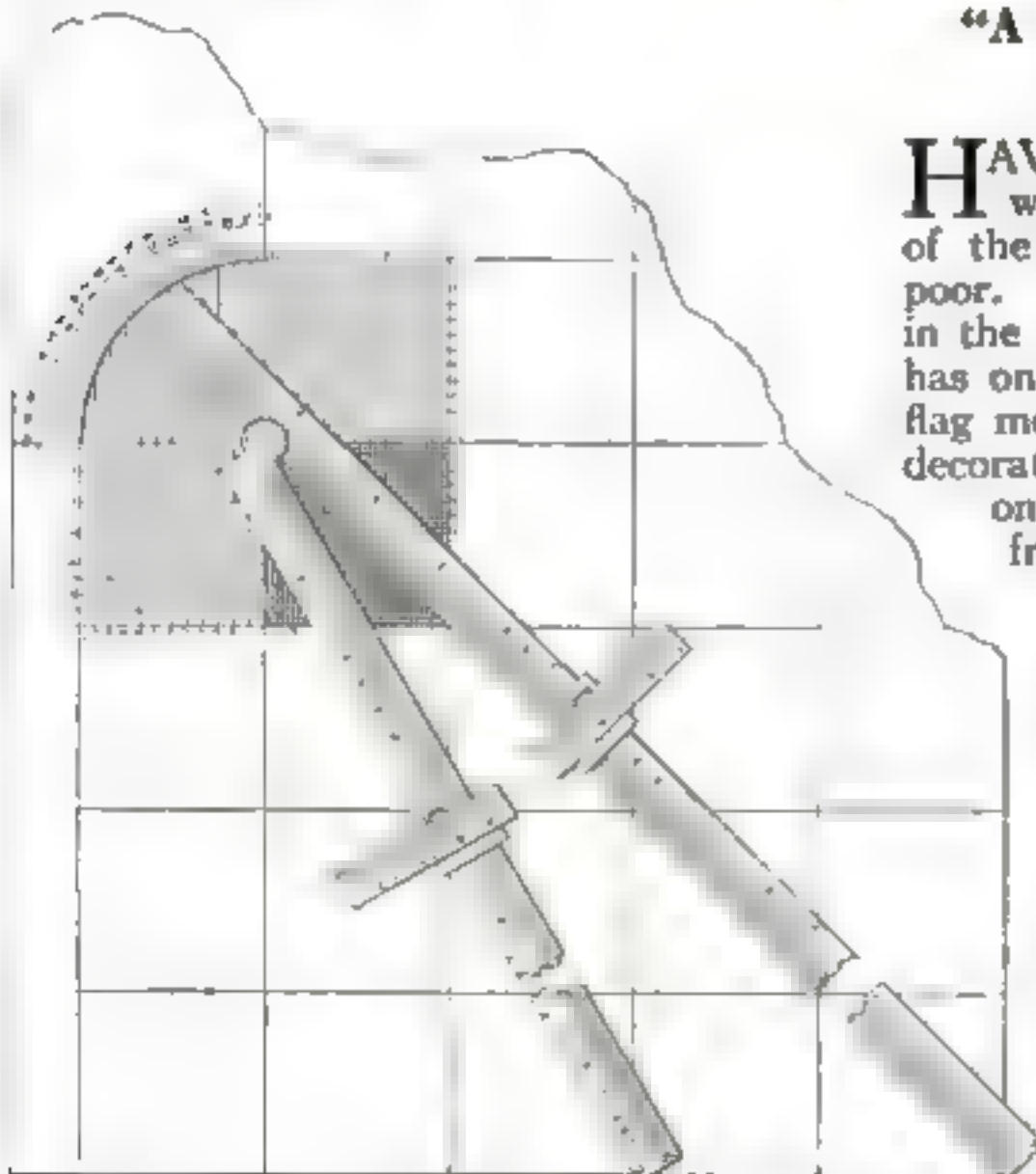


A placard supplied by the Navy to hang in the window of a house from which a man has gone to the war

"A Man from This House Is Now Serving His Country"

HAVE you seen a new flag lately? You will find it flying from the windows of the homes of both the rich and the poor. It is a red flag with a white panel in the center. Sometimes the white panel has one blue star, sometimes more. The flag means that a man from the house it decorates has gone to the war. If it has one star you will know that one man from that family is serving, if two stars, two men have gone to the front. It is unusual to see a service flag displaying three stars as does the one in the photograph, but there are families entitled to more than three. One house, from which five sons enlisted, waves two two-star flags and one with one star.

Another method of announcing that a man from a certain house is serving in the Navy is to hang a placard in the window which states, "A man from this house is now serving his country at the front in the United States Navy."



By using the principal dimensions in laying off the outlines of an intricate structure, any distances can be read

Snipping the Flames From a Natural Gas Well

Two streams of water were played in such a way that they formed a pair of water-shears



The men who played the hose on the flames were protected by great sheet iron shields

A sheet of water was edged in under the flame, completely shutting it off as at right

THE largest natural gas well in the world, near Monroe, La., burned for five and a half days and wasted 264,000,000 cubic feet of natural gas. Men who had had experience in fighting such fires were baffled by the magnitude of the blaze and the fierce heat. After all the known methods of fighting gas fires failed, William Guerin, formerly deputy fire chief of New York city, was sum-

moned. He had never seen a gas fire before. He amazed the local gas engineers by setting about to put it out with water. Men protected by sheet-iron shields played the hose on the fire from opposite directions. The streams met at the base of the flame and the force of the contact caused the water to be flattened out in the form of a horizontal fan. This sheet of water was edged in under the flame, thus shutting off the supply of gas from the point of ignition. The water was raised rapidly after the retreating flame to prevent back firing. By this method the fire was extinguished in ten minutes.

Special Cars for Persons Carrying Parcels

ANYONE who has ever had his knees bruised by bulky parcels carried by passengers in street cars will hope to see a plan recently adopted in Paris carried out in his home town. The Metropolitan, the Paris underground railway, has introduced a number of second-class compartments without seats for the special convenience of passengers with bulky parcels. The compartments are on the order of those provided for freight on ordinary trains. This experiment has resulted in far greater comfort for all the passengers. Occasionally a passenger will object to being compelled to board the special car with his bundles, but as a general rule no trouble is encountered.

The New Gun-Tunnel Airplane

It has removed the airplane's "blind spot" so that all the vital parts of an attacking machine are exposed to its fire



A "Gotha" engaging an ordinary airplane and, by means of its end-on, underneath fire, baffling the pursuer. The gunner is shown lying in the fuselage vault below the plane, along the tunnel of which he trains his gun to meet a tail attack. In no other type of airplane is this possible

THE latest development in military flying machines seems to be the German three-seated "Gotha." The design and construction are interesting because an effort has been made to give the passengers a fighting chance for their lives when they are placed in such a position that they cannot return the machine-gun fire of an aggressive adversary.

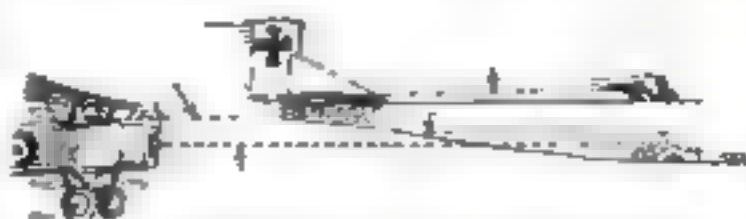
A flying machine moves in three directions. Therefore its guns should be able to fire up and down, from side to side, and fore and aft. Suppose that one machine is being pursued by another and suppose that the pursuer maintains a position somewhat below the tail of the pursued. Clearly, the advantage is all with the pursuer; the intervening tail of the pursued machine prevents his being fired upon from above.

The new Gotha is de-

signed to improve this precarious position of the pursued. Hence the fuselage or body of the machine is vaulted below like a tunnel, and along that tunnel a gun can be trained to meet a tail attack. The accompanying illustrations show the possibilities of the new construction so clearly that extended comments seem unnecessary.

It is evident that the military airplane is rapidly becoming distinctive in design. Hitherto there was no way of telling a military from a sporting machine, just as there was a time when a man-o'-war on the seas could not be distinguished from a merchantman at a distance.

The day is surely approaching when the construction of a fighting airplane will be as unmistakable as is that of a battleship. The great difficulty of mounting guns on warships so that their fire can not be im-



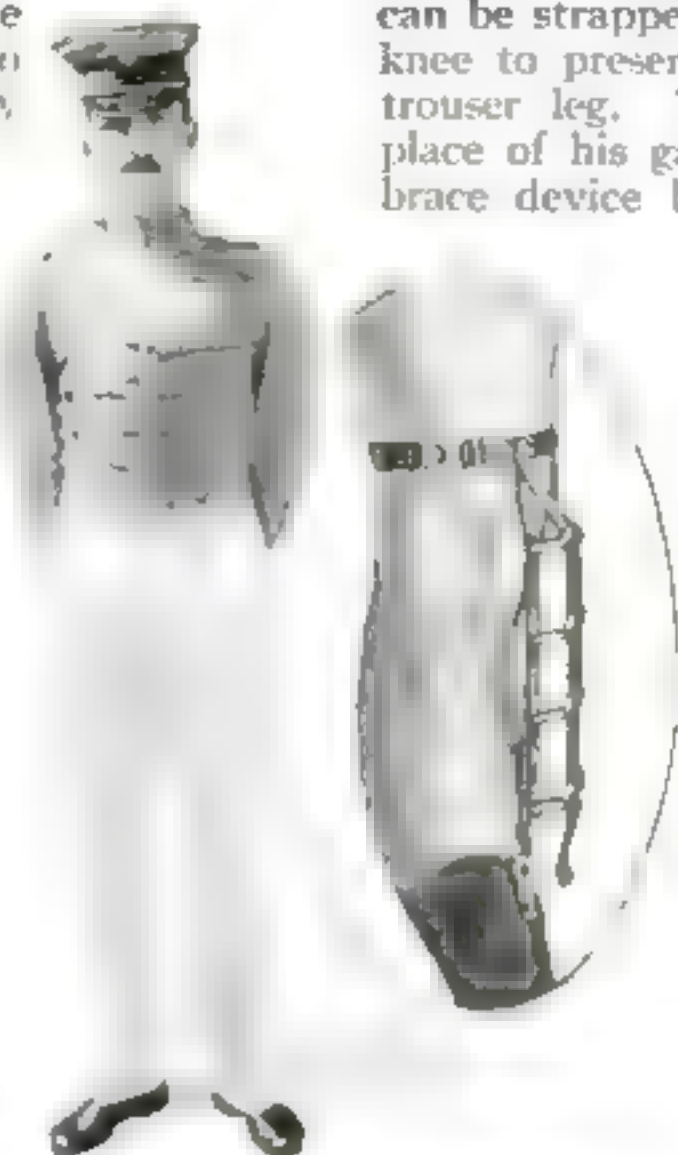
The dotted lines show the direction of fire between the two types of machines

peded has had its influence on naval architecture. Who can forget the warships of twenty-five years ago, bulging masses of sponsons as they were? All these eccentric curves, which almost concealed the true lines of the hull, were intended to increase the firing efficiency of the guns.

The Gotha marks a similar step in the evolution of the airplane. Because of the difficulty of mounting guns on a flying machine, odd shapes are beginning to appear in the air. The need for an inverted channel through which a three-inch rapid-fire gun could fire with ease was most imperative in the two-motored Gotha bombing machine, relatively the slowest of all German airplanes. Such a craft is likely to be called upon to engage in a running fight. Firing to the rear is not a new idea itself; but it has always been done over the top of the fuselage from the cockpit. There was left below the fuselage an immense dead angle in which a pursuing machine might securely attack.

No doubt the Gotha's tunneled tail will be imitated by the Allies; for their big bombing planes are even larger and slower than the Gotha. The number of guns that an air plane can carry are so limited by considerations of weight, that each must necessarily be so mounted as to secure the maximum efficiency. This is the point on which the Gotha shows its superiority.

By the adoption of a similar firing tunnel or vault for Zeppelins it is possible that the giant rigid dirigible which has dropped so low, recently, in the estimation of the German authorities, may be restored to military favor despite its vastly greater bulk and vulnerability when pitted against fast, elusive, fighting airplanes of later date, firing inflammatory bullets from machine guns.



Two straps held apart by adjustable metal struts keep the outline of the trouser leg always straight

Trousered Legs Are Not Always What They Seem

HERE is a boon for the bow-legged man. It is a light, flexible structure which can be strapped around the leg above the knee to preserve the straight line of the trouser leg. The strap would take the place of his garter, the lower end of the brace device being fastened to the sock with an ordinary garter-clasp. To the connecting strap a number of short lead struts are hinged. These are held projecting outward more or less horizontally from the leg. By adjusting the slope of these struts, the distance of the outer strap from the leg can be adjusted at the different points and this regulates the "bulge." The struts "give" sufficiently to prevent discomfort.

Sidewalks Flushed Without Disturbing Parked Cars

CHICAGO has discovered a way to flush her sidewalks without disturbing the automobiles and other vehicles which are parked along the curbing. Two automobile tank trucks are used to clean the downtown section of the city every night through a pipe extension to the discharge line as shown in the photograph below.



Flushing the sidewalk from an overhead pipe leading from the tank truck in the street

Testing the Fighting Aviator

Applicants for the aviation corps are converted into human gyroscopes in a special revolving chair in order to test their sense of equilibrium



By Dr. William F. Patten,

Captain, M. R. C., U. S. A., in charge of Physical Examining Unit, Aviation Service, Episcopal Eye, Ear, Nose and Throat Hospital, Washington, D. C.

FROM a military standpoint, a flight through the air brings into play the greatest anatomical, physiological and psychological functions of man. The guiding of an airplane is not the work of a weakling, a child, or a fool, but of a man in the most superlative sense. Hence it is that the experts of the Surgeon General's office have fixed the medical standards which must be met by applicants, standardized the methods of examination, and seen to it that only the physically fit are accepted.

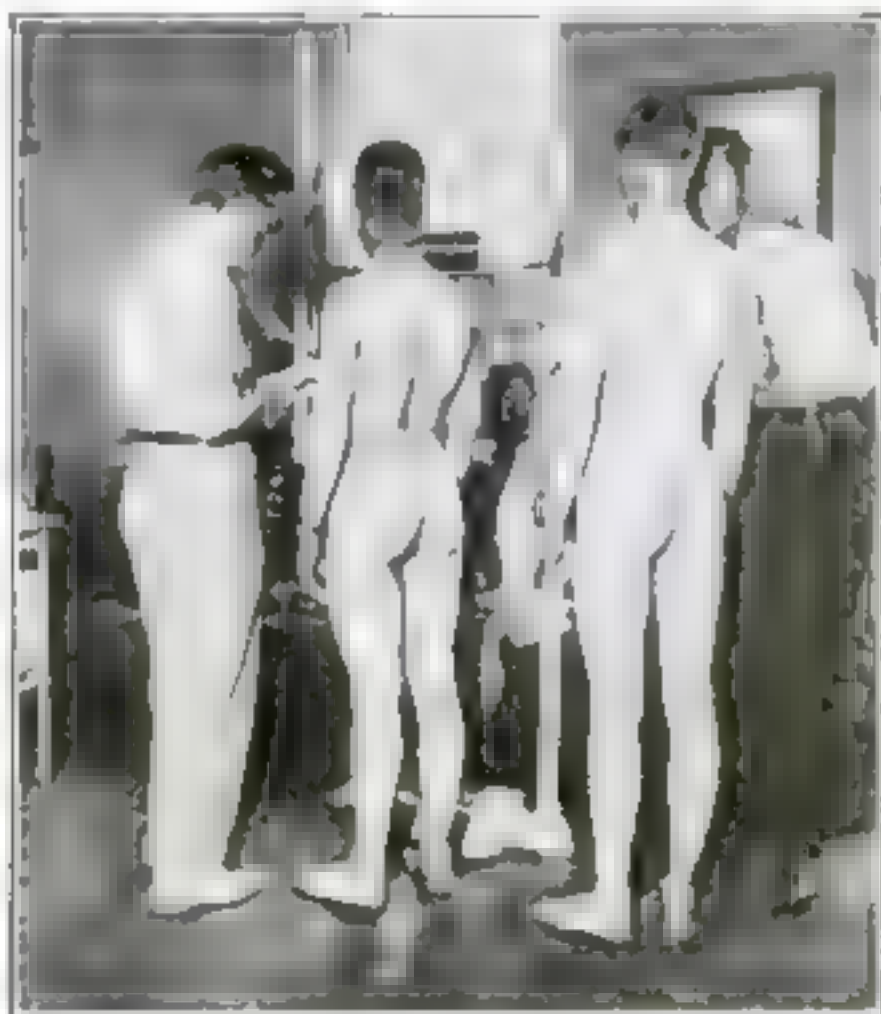
The men who wish to become flyers are tested by physical examining units, of which there are now some twenty in the United States. Each unit comprises a group of volunteer specialists. Experts on internal medicine examine the applicant physically; eye specialists test his vision; laryngologists determine whether there is any defect of the ear, nose and throat.

The examination for the determination of the blood pressure and the examination of the heart, lungs, blood vessels, bones, joints, muscles, skin and nervous system are exceedingly rigorous. The man who flies at a height of ten thousand, fifteen thousand, even twenty thousand feet (heights at which even skilled balloonists experience difficulty in maintaining physical poise) can be no weakling.

The Aviator Must Be a Physically Perfect Man

But even if he is sound of heart and sound of lung, he may still be rejected. His acuteness of vision must be exceptional.

Hence the eye expert makes a thorough examination to determine if the eye movements are normal and if stereoscopic vision is beyond question. The pupil of the eye must react normally to light and distance. The color sense must be perfect. Every test is conducted painstakingly with the most modern apparatus. Thus, the color sense is tested with what is known as the Jennings' self-recording equipment. A chart on which confusion colors appear on a perforated cardboard is exhibited to the applicant. One



Every Applicant Must Be a Perfect Specimen

The blood pressure is determined and the heart, lungs, blood vessels, bones, joints, muscles, skin and nervous system are carefully examined with the finest instruments. Flying cannot be the sport of weaklings

perforation corresponds with each color and shade. Some shade of red or green is shown, and the applicant is asked to name

Jennings' Self-Recording Color Test

A perforated cardboard exhibiting confusion colors is placed before the applicant, one perforation corresponding with each color and shade. Some shade of red or green is placed in front of the applicant and he is asked to name it and to select by punching through the perforations anything in the chart which contains red or green, as the case may be. These punches are recorded on a blank beneath the chart so arranged as to show whether or not they were punched correctly.

Testing the Muscle Balance of the Eye

The muscle balance of the eye must be in perfect alignment. In other words, there must be no latent tendency for the eye to turn up or down or in or out. If there is, the aviator may see double and thus endanger his life at a critical moment.



The Effect of the Different Head Positions

The position thirty degrees forward for purposes of whirling tests, brings the horizontal or external canal of the ear into the plane of the turning. This is the position used for the routine examinations for nystagmus and pass-pointing. Nystagmus is the term used to designate the visual disturbance set up by the whirling. It may be described as a rhythmic to and fro motion of the eyes consisting of two specific movements—a slow movement in one direction, followed immediately by a rapid movement in the opposite direction. This condition lasts only so long as the fluid within the canal tested continues to flow artificially. Placing the head ninety degrees forward would have the same effect upon this external canal as a superior canal running directly from ear to ear.



From a drawing by Prof. and Mrs. Winfield Scott Hall
in *Pictured Knowledge* (Lampton-Johnson Co.)

The Sixth Sense, the Sense of Balance, Lies in the Labyrinth of the Internal Ear

The internal ear or labyrinth consists of a bony and a membranous part, the latter contained in the former. The bony labyrinth is composed of the vestibule, the semi-circular canals and the cochlea. These three canals constitute what is known as the static labyrinth upon which we depend for our sense of balance. The bony canals contain the membranous canal, and the membranous canal in turn, contains the endolymph, which is a fluid that fills the membranous canal. The flowing of the endolymph in the semicircular canals is absolutely essential to man's normal station in space with eyes closed or in any situation in which he cannot judge his position by sight. Without a perfect labyrinth, a man could not fly safely for the simple reason that he would have no sense of balance.



Can He Pilot a Battleplane?

To find out if his sense of balance is good he is whirled around in a special chair. The object of the whirling is to displace the fluid in the labyrinth of the ear, the fluid that controls your sense of balance and tells you whether you are standing on your feet or your head. The examiners then note how long it takes him to recover position

it and to select, by punching through the perforations, anything in the chart which appears red or green, as the case may be. These punches are recorded on a blank beneath the chart, so arranged as to show

whether or not the selections were correct.

The eyes must be in perfect alinement. To determine whether they are or not, their muscle-balance, as it is called, is taken. In other words, they must show

no latent tendency to turn up or down, in or out. The test is important. If there were any such latent tendency, it would manifest itself under great strain; the aviator would see double and thus endanger his life.

And now the ear, nose and throat are examined. The hearing must be perfect; there must be neither diseased tonsils nor adenoids; both sides of the nose must be free, which means that there must be nothing present to prevent the automatic equalization of air pressure through the Eustachian tubes (the little tubes leading into the middle ear). A military aviator is subjected to a wide range of variation in temperature and atmospheric pressure. If his nose and throat are not normally ventilated these rapid changes might produce dizziness, vertigo and nausea. He might not be able to control his machine, with the result that he would wreck it and lose his life.

Your Sense of Balance Is in Your Ears

We have been taught that we have five senses—sight, hearing, touch, taste and smell. A sixth should be added—that of equilibrium. It is as much a separate sense as touch or sight, and that it is entitled to consideration as such, the development of aviation is fast driving home. Balance, or equilibrium, is maintained through the eyes, the skin, the joints and muscles, and, much as it may surprise you, the ears. Just as the end organ of sight is in the eye and the end organ of feeling in the fingers, so the end organ of equilibrium is to be found in the ears.

As the accompanying diagram shows, the inner ear is made up of two parts—a cochlea, which contains the end organ of hearing, and the labyrinth, which contains the end organ of balance. In other words, the labyrinth of the ear is the human stabilizer. Nevertheless, from the time

that man first discovered the possibilities of travel over the waters and hoisted his first sail over a log, down to the time when

he navigated great ocean liners, this little organ of balance has been the one thing that has made the sailing of the seas unpleasant. Not the stomach or liver, but the labyrinth is the cause of seasickness. Is it not singular that the organ which upsets us on the ocean stabilizes us in the air? Were it not for the constant intelligence flashed by the labyrinth to the brain, the aviator might actually find himself soaring upside down! His movements in the air up and down, right and left, in and out, are constantly registered by this won-

derful little piece of mechanism within



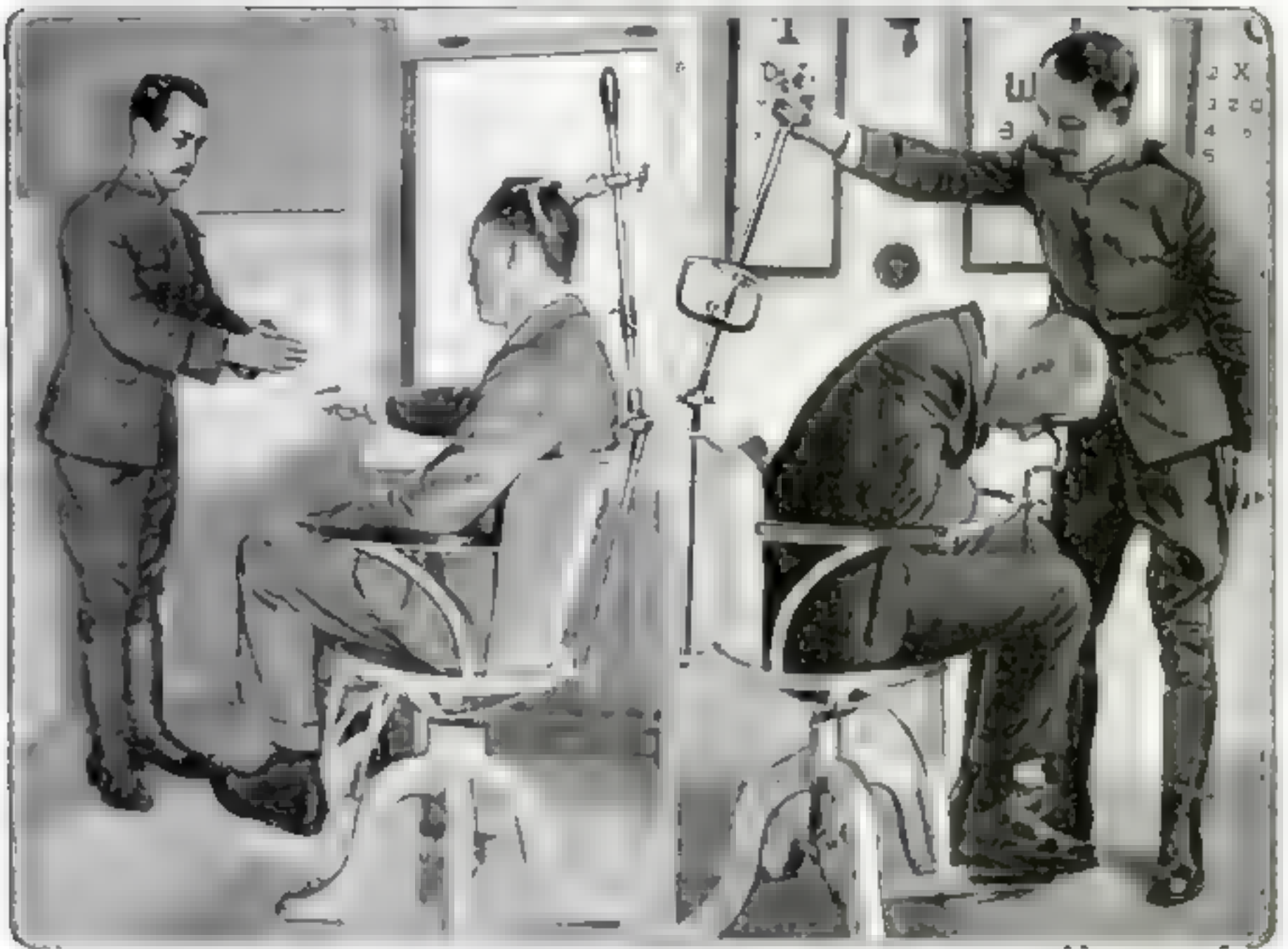
How Long Did It Take Him to Recover?

After having been revolved with eyes closed in the chair, the applicant is told to look at a distant object. There will be a rhythmic in and fro movement of the eyes. It lasts as long as the fluid within a particular canal in the ear continues to flow artificially.



The Test for Pass-Pointing

The applicant extends his right arm and touches the examiner's hand. Then he raises his arm vertically and is told to bring his finger back and touch the examiner's hand again. Another picture shows the result.



The Result of the Pass Point Test

The applicant is turned ten times in ten seconds to the left or right with eyes closed. The chair is brought to a sudden stop and his hand is seized by the examiner. He is told to raise his arm and to come back and touch the examiner's finger. This he cannot do for several seconds if the static labyrinth of his ear is normal.

Putting Him Through the Falling Test

The applicant is placed in a chair with his head forward approximately ninety degrees to bring the superior canal of the labyrinth of his ear on the level plane of turning. After having been turned five times in ten seconds to the left, for example, he feels that he is falling to the right when he sits up with his eyes closed.

his skull. Hence it is that the applicant is carefully tested to ascertain whether or not he has a normally reacting labyrinth.

Study the diagram on page 712 and you will see that the labyrinth is made up of three semicircular canals. Each canal presides over the movement of the head in the plane in which it runs.

The Wonderful Spirit Level in Your Head

Like the spirit level of a carpenter, these canals contain a fluid, which is known as the endolymph. Move the head in one direction and the endolymph moves in the opposite direction, thus acquainting you with your movements even though your eyes are closed. This telegraphing is done by way of the cerebellum (the coördinating center of the brain) to the muscles, the eyes and the higher centers of the brain. Thus, if you are normal, you are able to maintain an even keel. Only a very few drops of endolymph are provided—so small

are the canals. But these few drops are vitally essential to a man in maintaining a normal station in space, with eyes closed, or in any situation in which he cannot judge his position by sight.

You may gather from what you have thus far read that the Government considers the static labyrinth of the utmost importance in the examination of men who want to join the aviation corps. The function of the static labyrinth will be readily understood if we remember that it is made up of canals containing fluid and that each canal runs in a different direction and presides over the movements of the head in the plane in which it runs. If you move your head around the neck as a pivot, the fluid in the horizontal or external canal moves in the opposite direction. If you move your head from side to side, the fluid in the superior canal moves in the opposite direction. If the head is moved backward or forward, the fluid in the posterior canal moves in the opposite

direction. And so it is that the flowing of the endolymph within these canals acquaints us with the direction of our head movements.

Testing Ears to See If You Can Fly

Now since the testing of the static labyrinth is obviously dependent upon the movement of the fluid or endolymph within the canal, some means must be employed for causing the endolymph to flow within the canal. Hence, a special kind of revolving chair is used which is known as the "Jones' modification of the Barany chair." The applicant is seated in the chair and directed to incline his head thirty degrees forward. That brings the horizontal canal within the level plane of turning. With eyes closed, the applicant is whirled ten times in twenty seconds in this position. Then the chair is stopped, and the applicant is told to look at a distant object. The visual disturbance resulting from the experiment is known as the nystagmus. The duration of his nystagmus is noted with a stop watch; it should last in a normal person about twenty-six seconds. The nystagmus may be described as a rhythmic to and fro motion of the eyes, consisting of two movements—a slow movement in one direction which is followed at once by a rapid movement in the opposite direction. This nystagmus lasts only so long as the fluid within the canal tested continues to flow artificially.

The applicant is now turned in the opposite direction and tested in like manner.

Still seated in the revolving chair, unchanged in position and with eyes closed, the applicant is tested for "pass-pointing." He extends his right arm and touches the examiner's hand with his forefinger. From this position he raises his arm to a vertical

position and attempts to bring his finger back and touch the examiner's hand again. He is now turned ten times in ten seconds to the left or right. The chair is stopped and his hand is seized by the examiner. He is told to raise his arm and come back and touch the examiner's finger as before. He cannot do it if his static labyrinth is normal.

The underlying principle of the foregoing test is not difficult to understand. Since the applicant was turned to the right, in this case, and the chair stopped, the fluid in the horizontal canal continued to move to the right after the chair was stopped—continued to move, in other words, in the direction of turning. Hence, the applicant feels that he is being turned to the left, and in trying to locate the finger of the examiner, he naturally pass-points to the right.



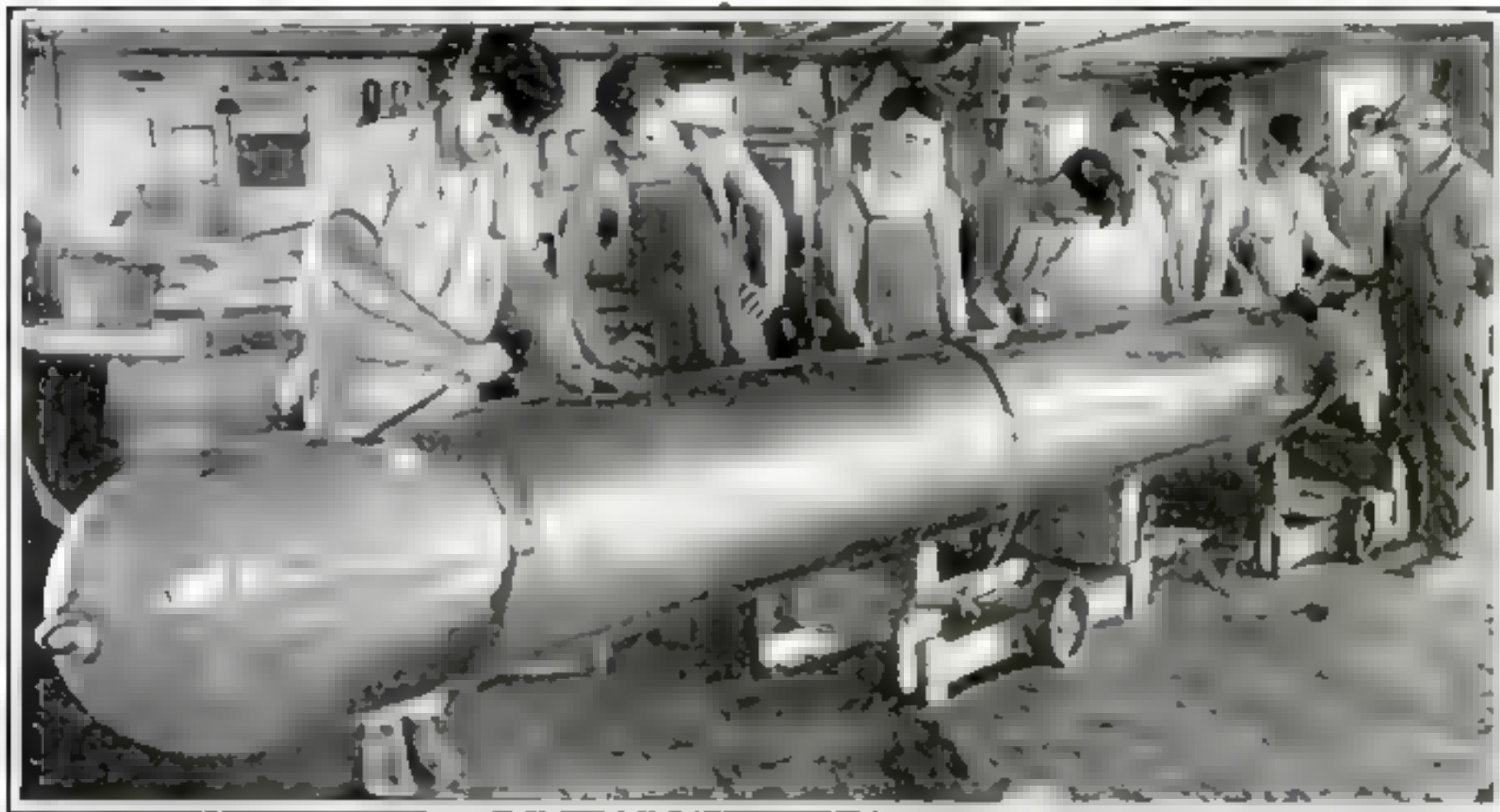
The Result of the Falling Test

After having been turned five times in ten seconds to the right or left, with eyes closed the applicant is told to look at a distant object. The visual disturbance resulting from the experiment is known as the nystagmus.



The Three Testing Positions

The whirling tests are made with the applicant seated with his head either at an angle of thirty degrees forward or at ninety degrees. The position sixty degrees backward is usually used for a douche or caloric test when the whirling tests are unsatisfactory.



Underwood and Underwood

The man in the foreground is setting the firing-pin. Those working at the tail of the torpedo are adjusting the powerful little air turbine prior to mounting the gyroscope in place

Assembling a Torpedo—It Requires Almost Every Type of Workman

A TORPEDO which will soon find its way into the hold of a United States warrior of the sea is interestingly depicted in the photograph on this page. The propelling machinery, the compressed-air valves and the firing mechanism have just arrived from the factories. These parts are being assembled in the torpedo on a naval barge "somewhere" along our coast.

Note the men working at the tail of the torpedo. In the small space but twenty inches in diameter they have placed the powerful little air turbine which will drive the twenty-five-hundred-pound projectile at a speed of forty-five miles an hour! They are adjusting this turbine, prior to mounting the gyroscope in place at the very end of the tail.

The compressed-air tank is already in its place in the center of the three compartments of the torpedo. The tank will hold air under the enormous pressure of two and a quarter tons per square inch. No wonder this air can propel the torpedo at such great speed when fed into the turbine.

There is little time lost in the as-

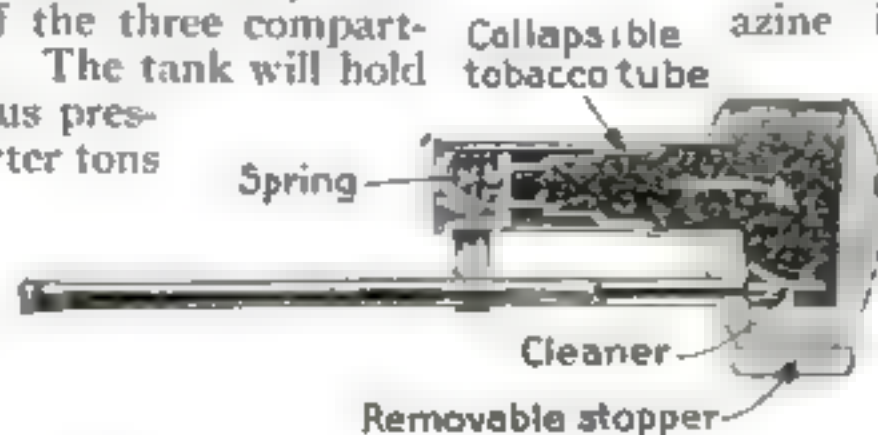
sembling after the interior "fine work" is done. One man does not perform his task and make way for the next. As is seen in the photograph above, while the man in the foreground is setting in the firing-pin mechanism, the finishers and adjusters are busy on the other portions and the painter is polishing off the nose.

A Self-Filling Pipe—It Works Like a Self-Feeding Stove

IF you are tired of filling that pipe of yours so often you may be glad to know that a self-filling pipe has been invented. James H. Hoefler, of Kentucky, has devised a pipe which has a tobacco magazine and which fills itself without troubling the smoker.

The great difficulty in making magazine pipes is to prevent the tobacco from clogging. This Mr. Hoefler has prevented by a

clever arrangement of the magazine in telescopic sections, each section holding its own tobacco. All sections are collapsible. The magazine may be attached to any pipe. So, on a fishing trip, for instance, all you need do is to fill the magazine and you can smoke all day long.

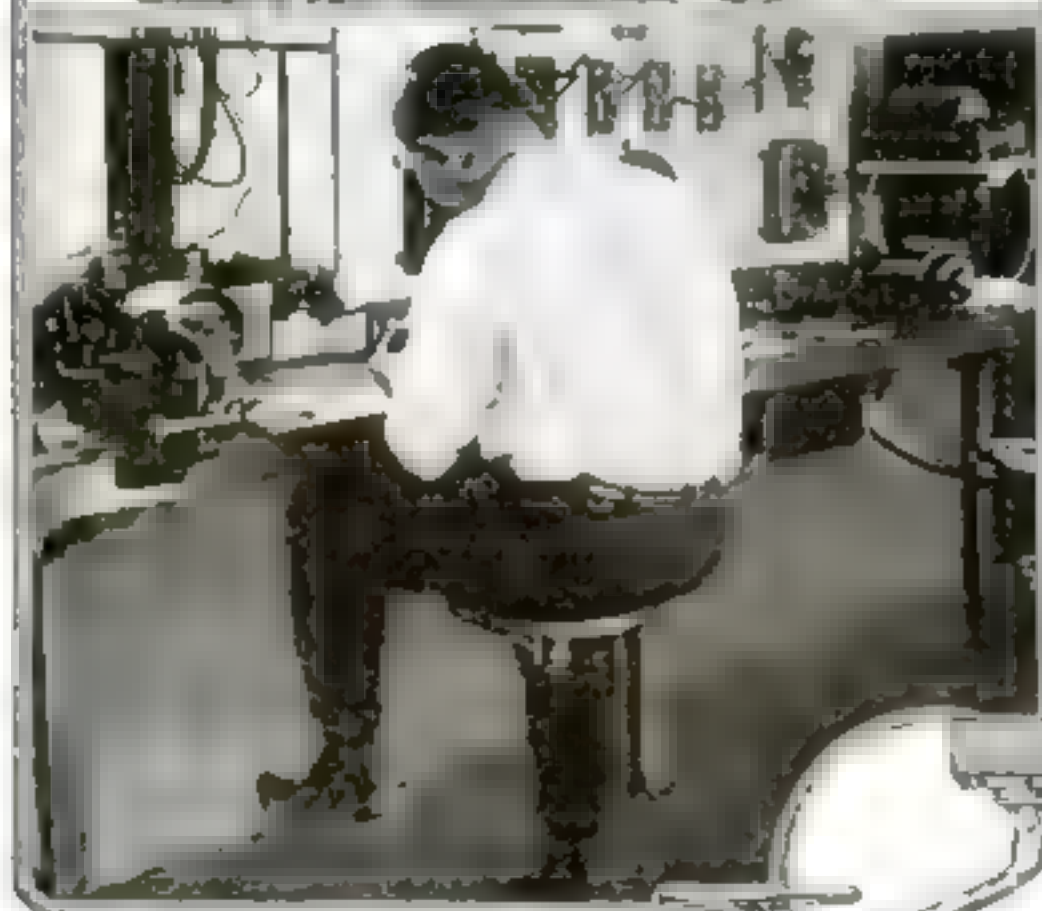
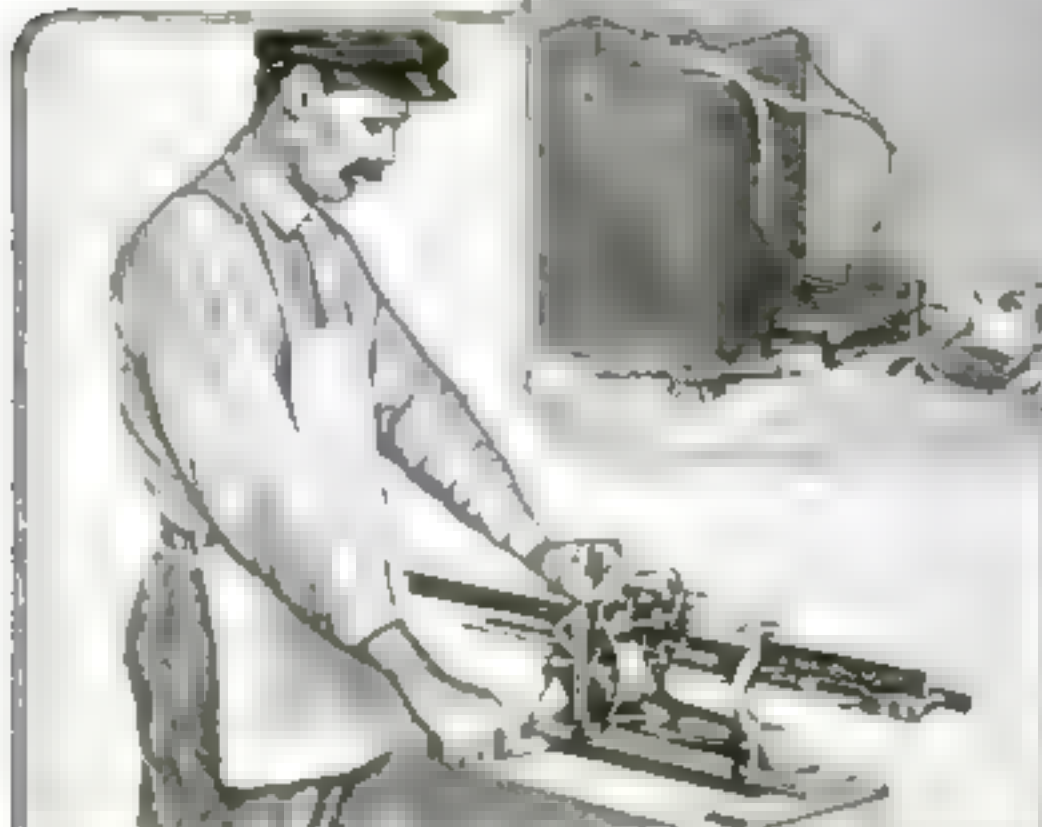


The self-feeding magazine attachment for a pipe. It makes a "smoke" an all-day affair

Do It with Tools and Machinery

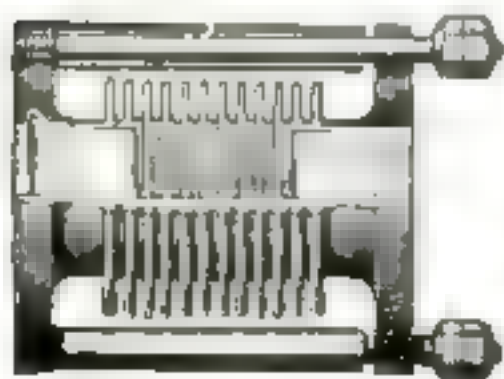
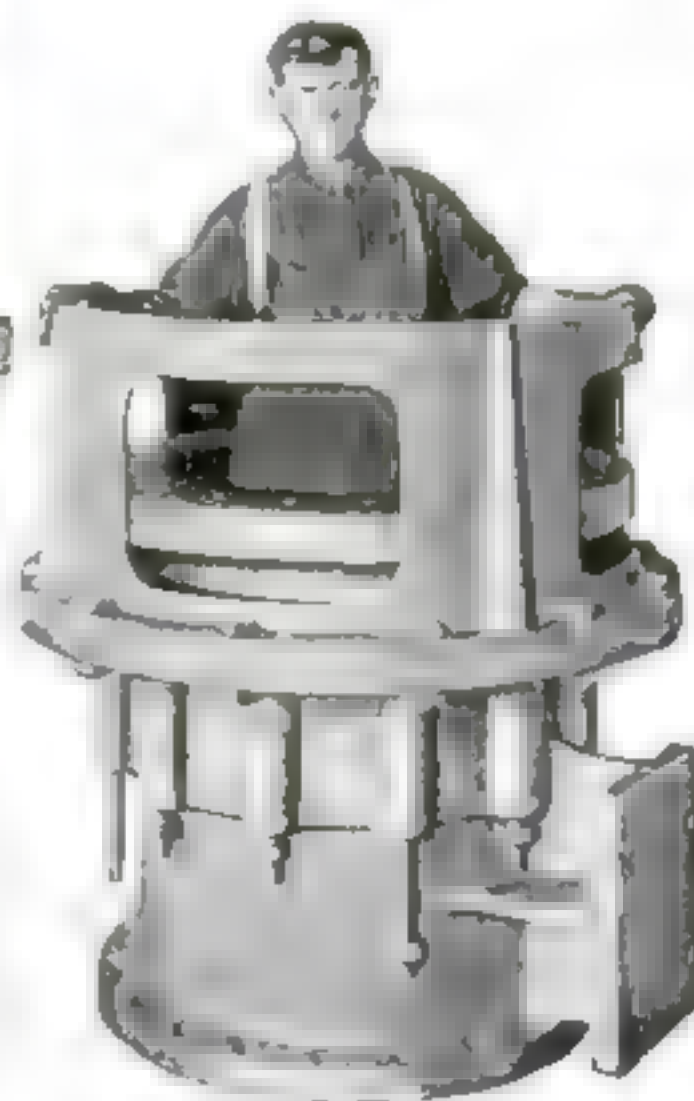
Below: An automatic saw file in operation. There is no guesswork. Each tooth files to an exact slope and length.

At left and below: An electric etching machine for factory use. It marks for identification costly steel mulling cutters, drills, etc.



A hammer with a wire-cutting attachment. It is operated by a thumbnut on the handle end. The space between the attachment and the inside surface of the claw is utilized for a pipe wrench.

Shop stools hung on a swivel joint. When not in use they swing back under the workbench.



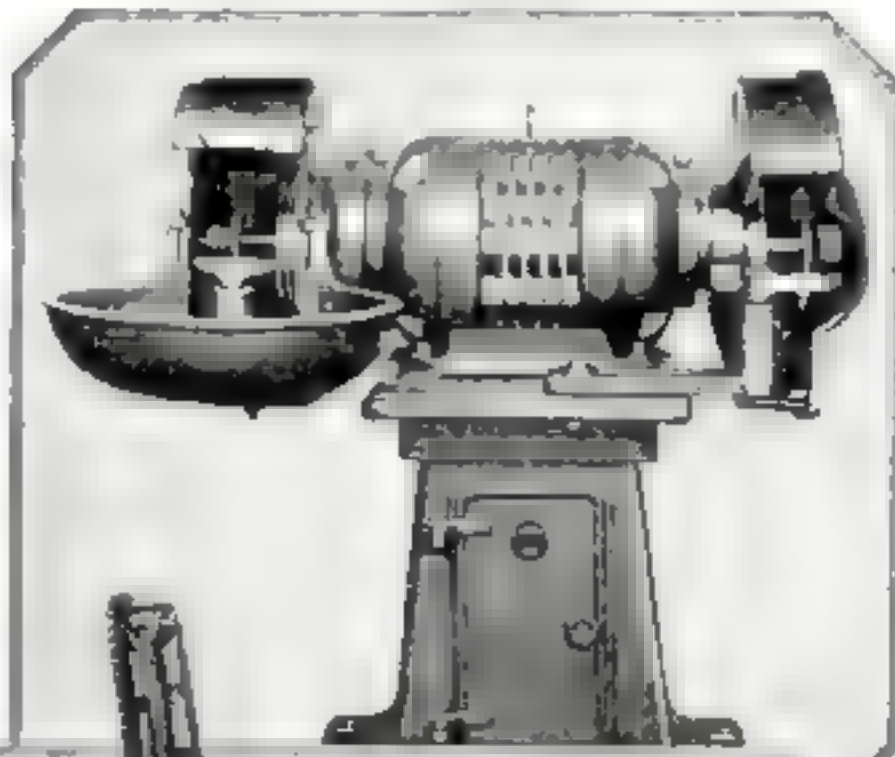
At left: A one-piece expansion joint that requires no pecking. It has a sweep of two inches in high temperatures.

At right: Another type of expansion joint in a large size, for use on pipe lines carrying liquids and vapors under pressure.

Do It With Tools and Machinery



The ring on the bottom of this oil gun makes it possible for you to pull out the indentation caused by the pressure on the bottom

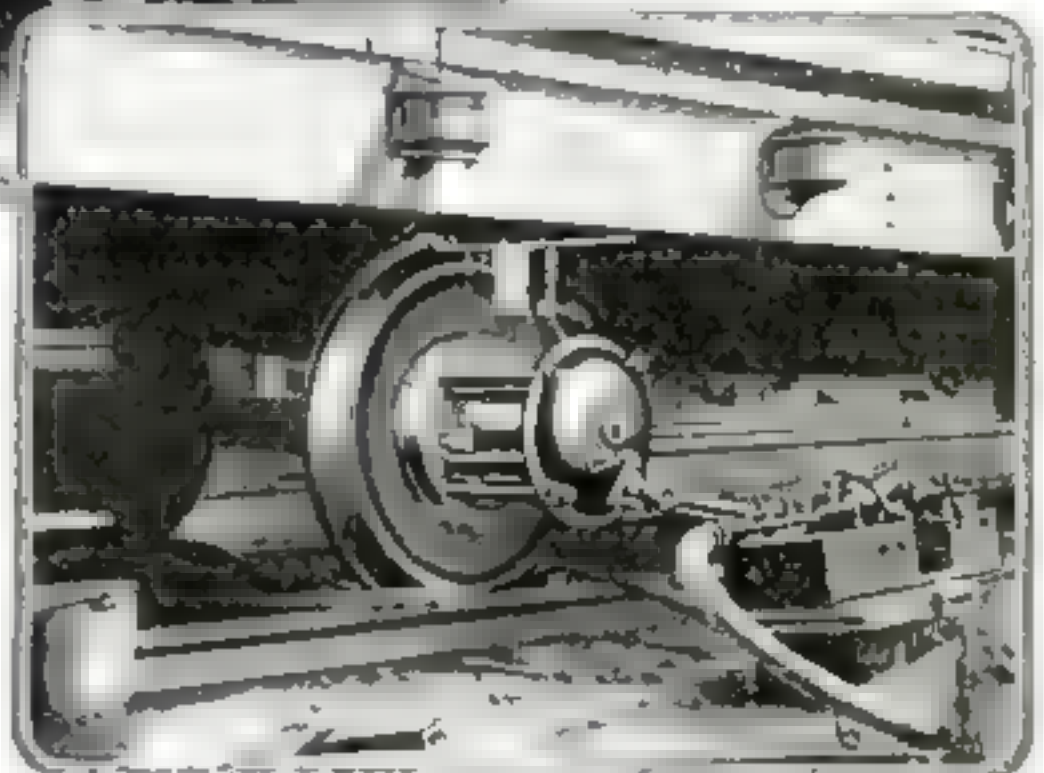


A universal counter-bore which can be used for boring holes, countersinking, hollow milling, drilling and facing

The center picture above shows a direct connected electric motor drive grinder in which one end of the arbor takes a wet wheel and the other a dry one. It also has a convenient catch basin



A post-hole digger operated from the engine of an automobile. It did the work of a dozen men



Truing a journal on the shaft of a car truck without removing it from the car or tracks. The machine that did the work was run by compressed air



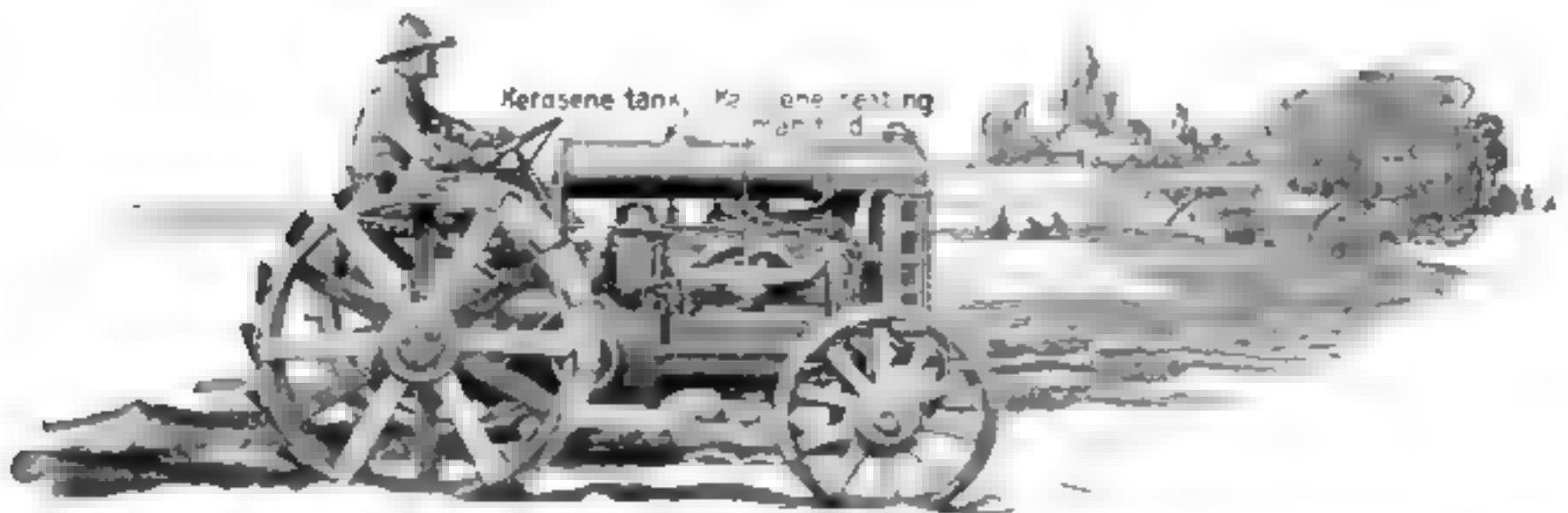
At left: An orange juice extractor made from a cast aluminum tea kettle. The reamer turns inside of the kettle

At right: An adjustable step form for concrete steps. It is easily set at the proper pitch and can be used by an amateur



Henry Ford's Kerosene Farm Tractor

It is being manufactured at the rate of fifty a day and with it Ford hopes to aid in solving the food problem



The tractor in use. The kerosene system requires a special manifold. The engine, transmission and rear axle housing are bolted together to form one piece which acts as the backbone of the machine.

HENRY FORD'S new farm tractor, which is expected to revolutionize the small tractor industry both in this country and abroad, will be produced at the rate of fifty per day at the Fort Dearborn, Mich., plant by the time this appears in print. The new unit will run on kerosene, although it may later be driven by alcohol as outlined in one of the first descriptions of the tractor, published exclusively in the August, 1917, issue of the POPULAR SCIENCE MONTHLY. As outlined in that issue, the first few thousand tractors produced will be absorbed by Great Britain.

Like the Ford passenger car and truck, the new tractor is characterized by the use of a large amount of high-grade material of the lightest weight and greatest strength. From the technical standpoint, the tractor differs from all others in that it has no frame but is built up on what might be called a unit plan in which the engine, transmission and rear axle housing are bolted together so as to form one solid piece which acts as the backbone of

the machine. In this way, parts which ordinarily perform but one function have been made to do the work of two or more. As the most notable example, the crankcase, gearbox and rear axle housing serve their regular purposes but also form the frame of the unit. This serves to reduce the tractor weight.

While the flywheel magneto type of the Ford car has been retained in the new tractor, the planetary gearset has been replaced by a three-speed and re-

verse gearbox of conventional design and the bevel final drive by a worm mounted under the axle instead of above it, as in most cases, for better lubrication of the worm and wheel assembly.

The motor used on the tractor is exactly similar to that used on the present Ford passenger automobile, except that it is larger and heavier.

As now fitted, the tractor will be started by gasoline and driven by kerosene. The kerosene system includes a special manifold for better fuel vaporization in which the intake passes through a coil surrounded by the exhaust gases.

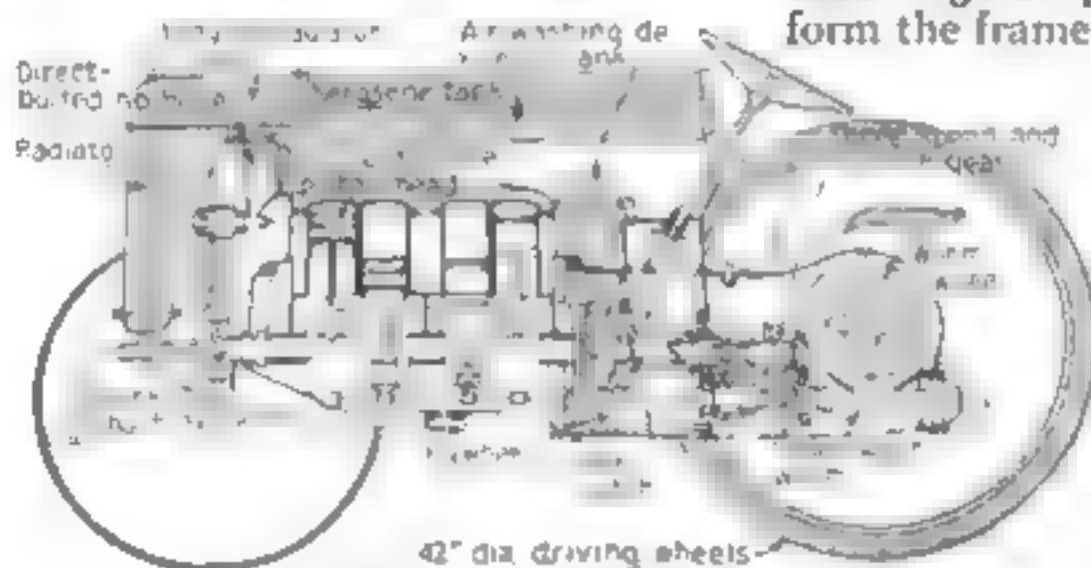


Diagram of the interior mechanism and driving system of the kerosene farm tractor

A Thirty-Five Acre Island of Mud Near Memphis

THE Mississippi River rises every year. Sometimes the overflow causes a great deal of damage and occasionally creates very unusual conditions. After the overflow of 1911 the citizens of Memphis, Tenn., noticed a small place in the harbor where mud rose above the water. No attention was paid to this condition until 1915 when the river again overflowed. After the water subsided Memphis found a thirty-five acre island in her harbor. This large tract of land threatened to cut off the city from the river trade. Dipper dredges are now at work removing the unwelcome land acquisition.



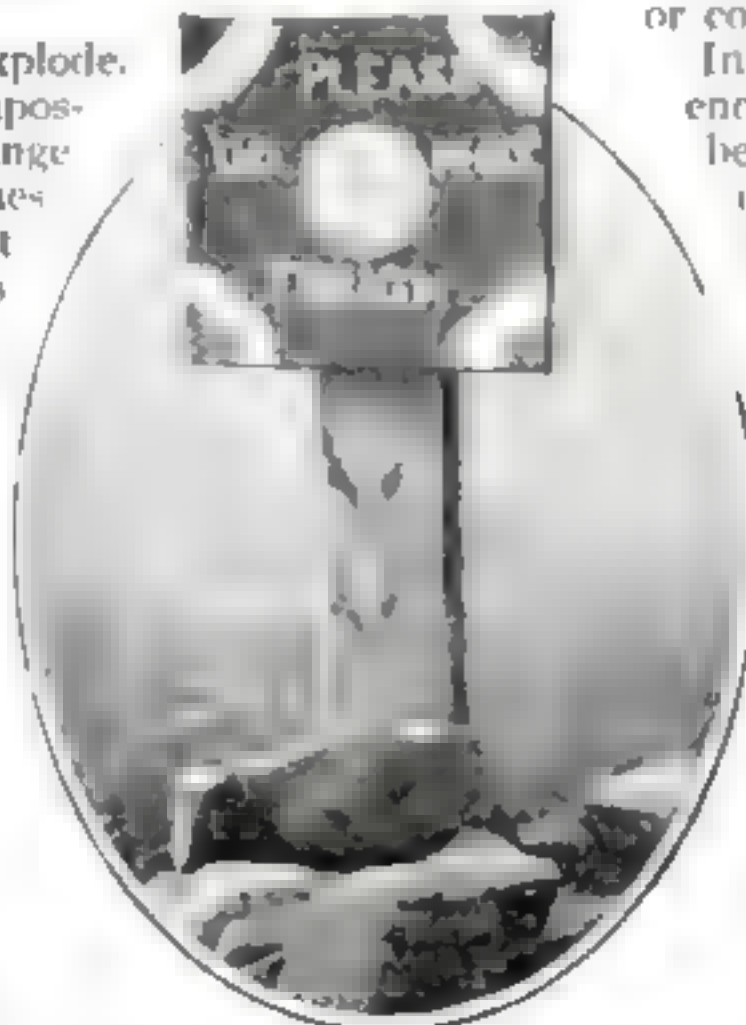
The combination heater-cooker. Details of the device are shown at left. Above: Eggs being cooked over the flame

A Temporary Tombstone for the Unexploded Shell

WHEN unexploded shells are found on the battlefield they are generally left alone. The soldiers have no desire to pick them up and carry them to camp, or even to examine them. But the shells are not entirely ignored. They are given part of the ceremony of a burial, in the way of a tombstone warning those who may pass by to keep on going and not to pay any attention to what lies under the ground.

Very few shells fail to explode. However, it is often impossible for a gunner or a range finder to know at all times whether every shell sent over the enemy's lines is exploding.

In Russia's great Galician campaign of 1916, when General Brusiloff captured more than one hundred thousand prisoners, several hundred Russian shells did not explode when they fell on enemy ground. It was not until the Russians captured these advanced positions that they found the defective shells, which are said to have been sold to the Russians by the Japanese themselves.



The danger sign, which marks the spot where lies buried an unexploded shell

Cook Over the Gas Lamp with This Combination Heater-Cooker

A LITTLE device has been invented which will permit hall room boys and girls to cook their evening meal without incurring the displeasure of their landladies. This miniature stove consists of clamps which may be fastened to either a ceiling or wall fixture, and two supports on which rests a disk of sheet iron strong enough to bear the weight of a small cooking utensil. You can easily fry eggs or cook a "rabbit" with it.

In case the room is not warm enough, the temperature may be raised by using the device as a heater. The heat from the gas light will make the iron disk so hot that it will raise the temperature considerably in the chilliest room. Of course it will not thoroughly heat a large room or even a medium-sized one, but it will help out between seasons before the janitor sends up steam, or later on when the fire in the furnace is low.

This convenient heater was invented by William H. Ketler of Camden, N. J. The entire heater weighs a little less than one pound.



The broad strip of film used in the machine equals the 75 feet of standard film shown above. At right is shown the combination machine using the broad strip



sary. In the photograph on the left, the inventor is shown with a piece of his own broad film in his hand, barely a foot long, and to the right a strip of standard film. It takes seventy-five feet of the standard film to equal the foot of broad film.

The machine is intended for amateurs. It will be appreciated also by parents who wish to preserve picture records of their growing children.

Building a Park Around the Debris of a Burned-Down Schoolhouse

SOME time ago the beautiful, two-story, Polytechnic High School of Fullerton, Cal., was completely gutted by fire. When the city decided to erect a new high school on a larger scale than the one which had been destroyed it was found necessary to select a new building site. In consequence the old grounds were aban-

doned and lay as a "white elephant" on the hands of the city until an enterprising member of the city board of trustees conceived the plan of converting the plot into a park at a minimum expenditure of money. The plan was adopted. The debris from the fire was cleared off the ground, with the exception of the stately arch of concrete and the front foundation of the old building. These told a story and were ornamental so they were incorporated into the new park

Making Pictures and Projecting Them with the Same Machine

A MACHINE that will not only take motion pictures but will also project them is the invention of Kasimir de Proszynski. It is about the size of a folding typewriter. Its weight is four pounds.

Instead of using the ordinary standard film, on which the pictures are the size of a postage stamp, it has its own film, which is about the width of an envelope. On this negative the pictures are exposed, each one about the size of a baby's finger nail. From the negative a print is made and this in turn is placed in the machine and used to project the picture on the wall. The lens used in taking the pictures is used again in projecting them. This is done by the aid of a small lamp, the light for which may be secured from any socket.

Instead of taking the pictures lengthwise of the film, the pictures are exposed across, as in reading. The diminutive size of the pictures makes only a small amount of film neces-



The concrete arch of the entrance and foundations of the school were left standing for park ornaments

Loading Cattle on Trains in a New Way

The cattle enter through the rear door of the end car and walk through the train to the first car, each front car being shut off as it is filled

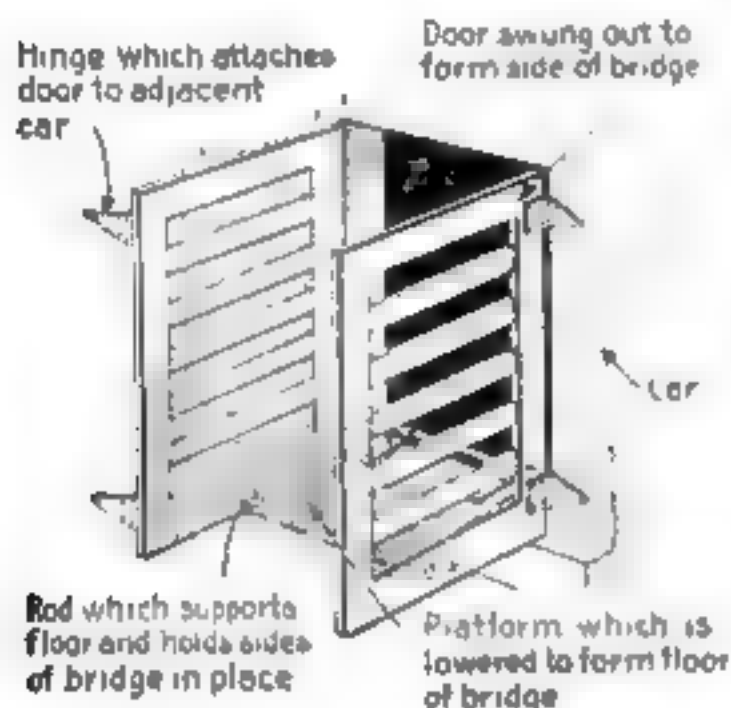
OREGON has produced a man who has tried to relieve the trials and tribulations of railroads by inventing a new way of loading cattle on freight-trains. The present-day method is long and tedious. As the loading is done from one spot and as there are no connections between cars, only one car can be filled at a time. When one car is full the train is moved on until the next car is in the loading position—and so on.

According to the new method, all the cars can be loaded through one opening. This is accomplished by placing the doors of each car at the rear and front ends

instead of at the sides. When the train is to be loaded the door of each car is swung out to form the side of a bridge between the car itself and the adjacent car.

The doors of two adjacent cars are hinged on opposite sides so that when both doors are swung out both sides of the bridge will be formed. Two platforms which fit behind the doors are lowered to form the floor of the bridge. The cattle are loaded from the rear end of the last car and are made to keep moving until they reach the first one. When the train is full the bridge-like connections are put back in place and the train starts for the slaughter-house.

In this way not only is a considerable amount of time saved, but the panic which is so often experienced by the animals herded together in the paddock waiting to be driven into the cars is avoided. Indirectly this may affect the market price of the cattle for they will be likely to lose less weight on the trip.



Attendants keep the line of cattle moving until the forward cars are reached, the hinged doors being shut again as the cars are filled



The windmill causes the bright-colored yarn which is used as bait to dance continually over the water like "flies," luring the fish

Fishing for Herring with Bits of Yarn and a Windmill

FISHING for herring with a windmill may sound strange, yet this is precisely what may be seen most any day at Ocean Park, California.

The herring are fished for without any bait. They are lured by what is commonly known as a "Japanese hook", that is, a small hook baited with bits of brightly colored yarn, which are dangled over the water by the fisherman. The fish snap at the bits of yarn apparently mistaking them for insects.

The idea of the windmill originated with Frank Volk, a salty old pier fisherman. The constant shaking of the fish pole became irksome to him

so he conceived the idea of letting the wind do the work for him. He whittled out a little windmill and fastened his herring line to it in such a manner that the turning of the mill twists the line and causes his hooks to spin about over the surface of the water, or just under the surface, with all the vigor of a lively insect. "When the herring are running," says Volk, "they get on the windmill line just about as fast as I can pull them up."

There is always plenty of wind on the pier to make the windmills spin. Volk's success with the mill has been so great that other people have adopted the idea, and now you may see windmills all along the pleasure piers of Southern California.

Iron Signs Give Good Advice to Washington Tourists

VISITORS to the National Capital have an opportunity to receive much wholesome advice as to how they and the local police force can co-operate to mutual advantage. The advice is conveyed by iron signs placed at various prominent corners in Washington, where it is not possible to avoid them.

One sign, for instance, tells the traveler that "The policeman is your best friend" and in general terms explains how he is trained to do his duty.

On the reverse side of the same sign is another message, which warns pedestrians not to expose their money in public. "Pickpockets would have to go out of business if men became careful in handling their money," says one sign. Placed opposite the Union station, is a sign which advises house owners not to leave their homes unguarded. The idea was originated by the head of the Washington police department and the messages have been widely read because of the many visitors who daily come to the Capital, even in wartime.



Warnings and good advice displayed so that he who runs may read

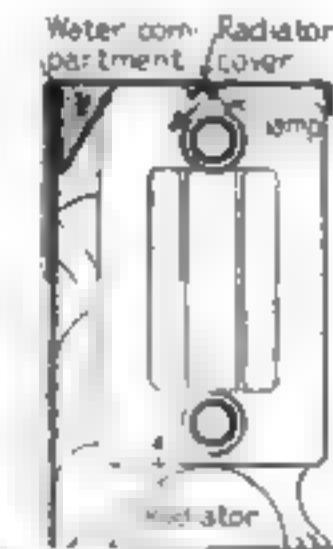
Making a Window Seat Out of the Radiator

THE ordinary steam radiator is concededly ugly. That is why a Chicago inventor has patented the radiator cover shown in the accompanying illustration. It is intended to convert the radiator into a window seat, while preserving its general lines and increasing its ornamental properties.

The cover is made of heavy sheet metal, fastened to the radiator at intervals to prevent slipping or rattling noises. Its special feature is a trough for holding water to supply moisture to the air. This trough is carried at the back of the radiator and under the cover, so that the water is hidden from view and kept free from dust and from danger of being upset.

Perhaps the best service which the cover performs is to deflect the heated moistened air to the floor, so that the floor is warmed somewhat before the air rises, as it naturally will. The cover is made in adjustable sections.

Details of the device for covering the radiator. It has a concealed water-trough for supplying moisture to the air



In summer, when there is no heat in the radiator, it still does duty as an ornamental shelf



The diving board, which is the principal attraction of this pool, is simply a board one foot wide, supported on horses

Making the Swimming Pool Attractive as Well as Efficient

IT is not enough that the ocean should be brought indoors for the benefit of the patrons of a swimming pool. The trend of the times is to make that particular bit of ocean or clear water as attractive for its setting as for the benefits and pleasure derived from the swimming. The accompanying photograph shows a swimming pool de luxe. It has tiled paths surrounding it and latticed effects on the walls, where flowers and vines are used as decorations. Palms and growing plants are used in every available spot to add to the outdoor impression.

But while the appeal of the beautiful in the decorative scheme is insistent, that of the diving board shown in the foreground is most noticeable.

Showing House Numbers on Street Signs at Corners

A new type of street sign has appeared in Cincinnati, Ohio, which shows the number of the corner house as well as the name or number of the avenue and street.

The idea of putting the number of the corner house on the street sign is a happy one, for by looking for the number of the house on the corner, a person need never go more than one block beyond his destination.

Leather from the Sea

Our old enemy the shark helps
to reduce the cost of living

By A. M. Jungmann



A shoe made of shark skin. It seems a good deal like any other shoe, doesn't it? And it is, except in cheapness

THIS is a new kind of shark story. Heretofore, all we have heard of sharks are harrowing tales of their vicious attacks on man. We now can sit back and smile with satisfaction at the sight of these tigers of the sea expiating their crimes by cutting down the cost of living. The shark is no longer our implacable enemy. It is a servant that will supply us with uncountable millions of feet of leather.

As soon as they are caught the sharks are skinned by slitting the hide up the back. All the flesh is trimmed from the hide. Then the skins are laid on the floor, skin side down, and the flesh side covered with a layer of salt. Skins are piled in stacks three or four feet high.

In Juneau, Alaska, the fishermen place shark skins in a brine bath for eight days before packing them. When they are taken out of the brine tanks they are dried and salted just as fresh skins are treated. All skins must be salted from three to five days before they are packed for shipment. Thick skins require a longer period of salting than do thin ones.

The skins are packed in any serviceable way. Second-hand sugar or flour barrels answer admirably. If the hides are torn by nail points their value is greatly lessened. For this reason fishermen have to be careful in removing the flesh from the skin. A single slip of the knife may ruin a fine skin.

Tanning fish skins is a slow and complicated process, as in fact, is all tanning.

The method now being used was invented and patented by Kristian Bendixen, of Denmark.

Bendixen soaks the salted skins in fresh water until the salt is removed. Shark skins are stretched on frames and dried. The scales or spikes are scraped off with a tanner's knife. Next the skins are softened in lukewarm water and worked over a beam. The hides are then ready for a three-day bath in another special solution. When that is finished they get another three-day bath in a solution of water and slaked lime. Now comes a short bath of water and hydrochloric acid.

This is followed by bating the skins in a mill containing water, poultry dung and a chemical bating compound. Once more they get a lukewarm water bath followed by another bath in a solution of hydrochloric acid and water. Next they are treated with a solution of salt and tanning material. Finally they receive a six-hour bath of sumach and water.

The next step in making fish-hide leather is to color the skins, smear them with oil, dry them, damp them again, smooth them out well, polish and bleach them. After this they are rubbed well with



The shark hides are laid over a beam and scraped with knives to remove all bits of flesh

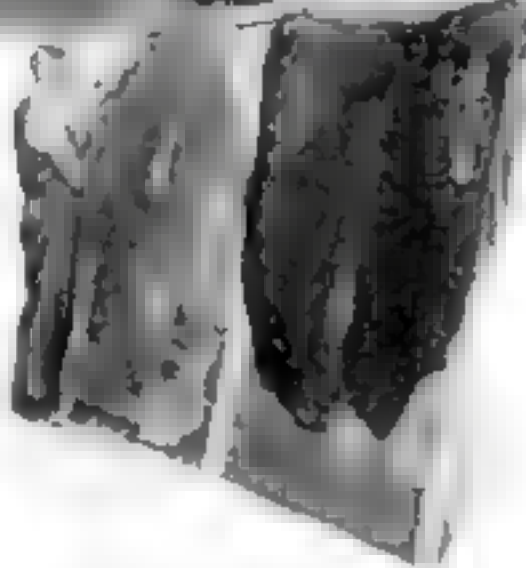


The skin is laid over a rounded board and thoroughly buffed with a buffer which slips over the hand like a loose mitten

albumen and water or skimmed milk, which makes them very supple. They are then glazed and grained.

Experiments which have been made with it indicate that shark leather may be used for practically everything now made of cattle leather. Shark hides have one great advantage over cow hides in that the "splits" are amazingly strong. A "split" is simply a peeling of the hide—something like the veneer cut from a slab of wood.

All the leather that you see is not made of the whole skin. Hides are split, and each split is finished to resemble, as closely



At various stages of the tanning process the skins must be dried. Here are two on drying frames

A thoroughly cured shark skin being glazed by electricity. The skin is held taut and the glazing machine is passed over it

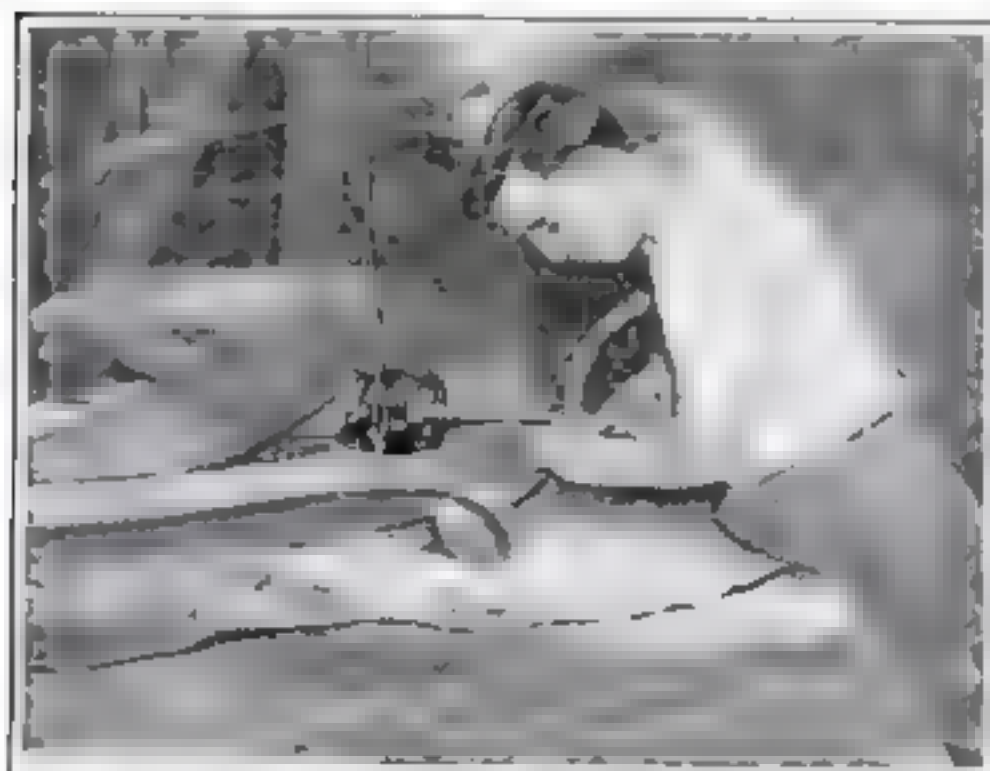
as possible, the skin of the hide. If all leather were made of the skin side there would not be nearly enough to go around. Present demands for leather are so heavy that even with the use of splits leather is growing alarmingly scarce.

No matter how carefully a cow-hide split is treated it will not wear as well as the first, or skin layer. If the split is creased it immediately roughens, and the surface cracks. This is due to the grain of the skin.

Shark hide is not grained like cow hide. In the shark hide the grain runs in such a way as to form what might be termed a web, which prevents the splits from cracking. A split of shark hide may be creased, folded, flattened and pressed down, yet it will retain all the smoothness of the outer layer.

Shark leather costs less per foot than cow leather. Therefore articles made from it will be cheaper than those manufactured from cow hide.

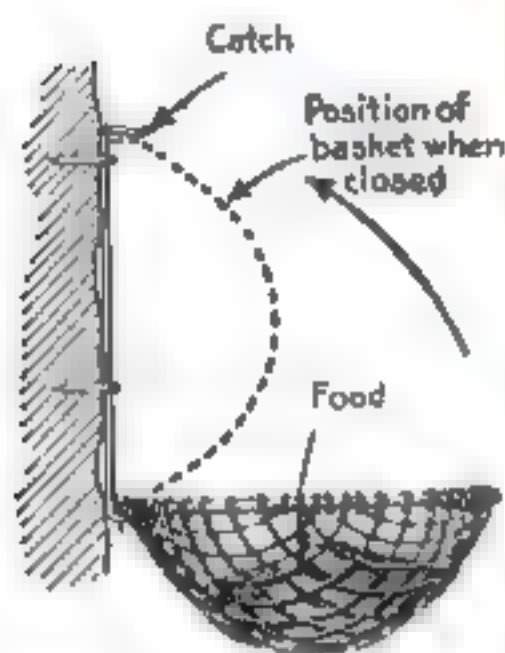
In these days of high-priced leather the family's shoes are no longer a small item of expense. Let worried fathers take hope for the future. Next year they may be able to purchase shoes for themselves, their wives and their children at about three dollars a pair for the grown-ups, and somewhat less for the children, all made from shark hide.



On the grain side of the skin the buffing is done with an electric buffing machine

Providing a Treat for the Birds in Cold Weather

THERE is nothing which birds appreciate more during cold weather than bits of suet placed conveniently on a tree or other outdoor support. Usually the suet is tied to a tree with a string. But this is not the most satisfactory method, by any means. It entails too much fussing with the string in the cold, and the string does not always hold the suet securely enough to prevent its being wasted.



Placing the suet in the basket for the birds. When it is filled it is tilted up against the tree and held fast there. At left is shown the basket in detail.

The best device for the purpose is one which has been designed by Beecher S. Bowdish, of Demarest, New Jersey. It consists of a concave basket fastened to a base having legs which clutch the tree and turn up at the ends to form bearings on which the frame of the basket is pivoted.

To fill the basket, you simply unhook it at the top by pressing the two legs together. You can then draw the basket down to horizontal position. After it is filled you tilt it up again and snap the frame over the hooked portion at the top.

Paper Uniforms the Latest Style for German Soldiers

THE clothing of some German prisoners recently taken by the British was of such a peculiar appearance that the Englishmen decided to analyze it. The uniforms the officers wore were found to have been made of cloth woven from leather fiber, while the enlisted men wore uniforms made from paper fiber. The fabrics resemble the regulation army cloth used for uniforms.

A New Map-Holder for the Aviator. It Holds the Map in a Scroll

MAPS are to the aviator what charts are to the navigator. Not only are they used to keep a pilot going on the most direct course; but also, as the charts enable a ship to keep off dangerous shoals, so do the maps assist in warning an aeronaut of dangerous landing places.

To keep in plain sight the portions of the map which correspond with the territory over which a pilot is flying is therefore of first importance. A special map-holder had therefore to be invented. A photograph of it is given in the illustration below.

The holder is less than a foot square and is placed on the instrument board directly in front of the aviator. The long map is wound upon two rollers. By simply turning the proper roller, which is within easy reach, the

territory which the airplane is approaching can be located. At night, this map can be easily seen by turning on the electric lights placed in back of it.



The map is wound on a roller, and is unwound gradually to reveal the exact location over which the airplane is passing in its flight.

A Bullet That Flies Like a Comet

Emitting a stream of sparks,
it informs its senders of its
direction and point of impact

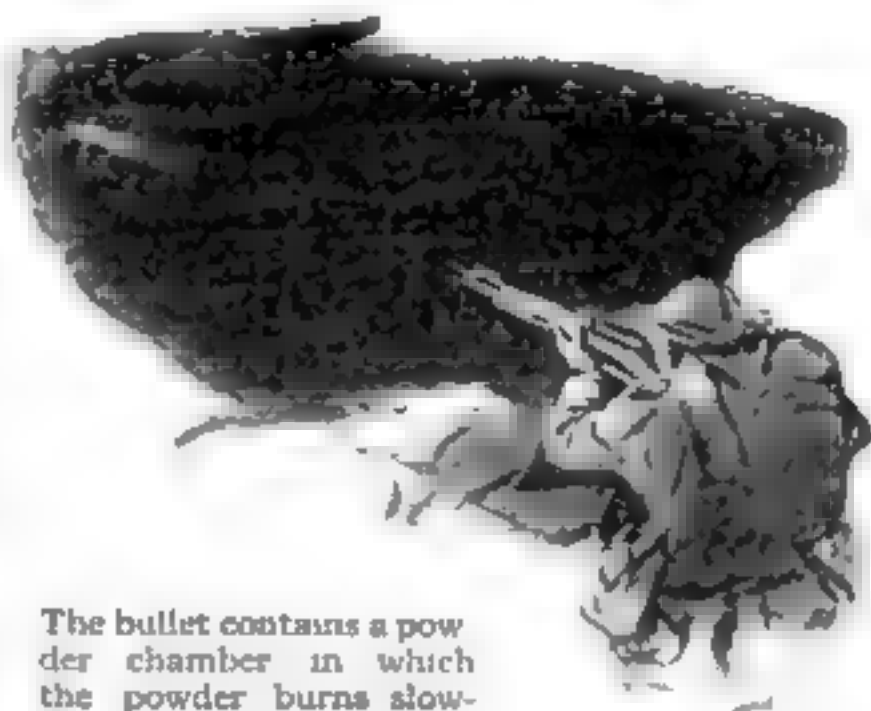
LET the good rifle shot, or the officer in charge of a company, see the flight and strike of the first bullet or so—and those that follow will strike the mark because immediate correction in the sight-setting can be made. It is embarrassing when the enemy selects a ground that will not show bullet impact, such as turf or low weeds or damp soil from which no puff of dust will rise.

Wherefore the tracer shell for field guns and small arms. If you can make a shell or bullet display a trail of smoke by day or of fire by night like a comet, you can easily trace it to its ultimate destination and alter the sights accordingly. The shell of the field gun lends itself most readily to the installation of smoke and fire-making machinery. The trouble is that the weight and the weight distribution and the balance of such shells are quite likely to be different from the high explosive or shrapnel missile, and so the tale told by the tracer missile does not necessarily apply to the real deadly missiles you want to fire.

An Englishman, George T. Revill, patents what he terms an "incendiary bullet" for this purpose—the term has nothing to do with setting fire to the barn of a man you don't like, but merely to a bullet to display fire during flight.

This tell-tale missile has a compartment with a narrow bottle-neck passage filled with gasoline or gunpowder. As a lighting device the inventor uses a coiled spring and a wheel with projections to rub over a flint and produce sparks hot enough to ignite the powder or gasoline. The powder, confined in its chamber, is arranged to burn slowly *à la* sky-rocket, emitting a stream of sparks for the instruction of the firers of the missile. The gasoline is backed up by compressed air contained in a compartment ahead of it. The air drives out the gasoline in spray, which in turn takes fire and forms a comet-tail.

Another modification has an incandescent



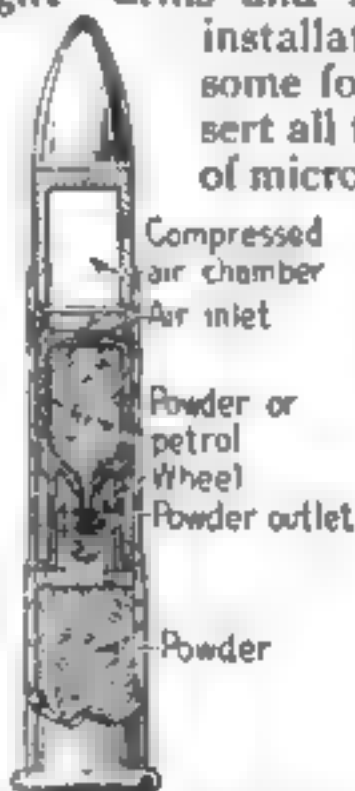
The bullet contains a powder chamber in which the powder burns slowly as in a sky-rocket

burner to light up the course of the missile.

The inventor terms these projectiles bullets, but as bullets are missiles for small arms and not over .30 inch across, the installation mentioned seems cumbersome for a bullet of this size. To insert all this mechanism in place is a job of microscopy worse than engraving the

Lord's Prayer on a ten-cent piece. The inventor probably means shells for artillery.

What several inventors have turned out, and what is really needed, is a practical smoke-trail bullet for rifles, to show its point of impact. The puff of smoke from shrapnel does away in daytime with any necessity for a device to show its flight; the patent referred to here is for night-firing alone.



Cross-section of the fire-display bullet. As a lighting device, the inventor uses a coiled spring and wheel with projections to rub on flint to make sparks

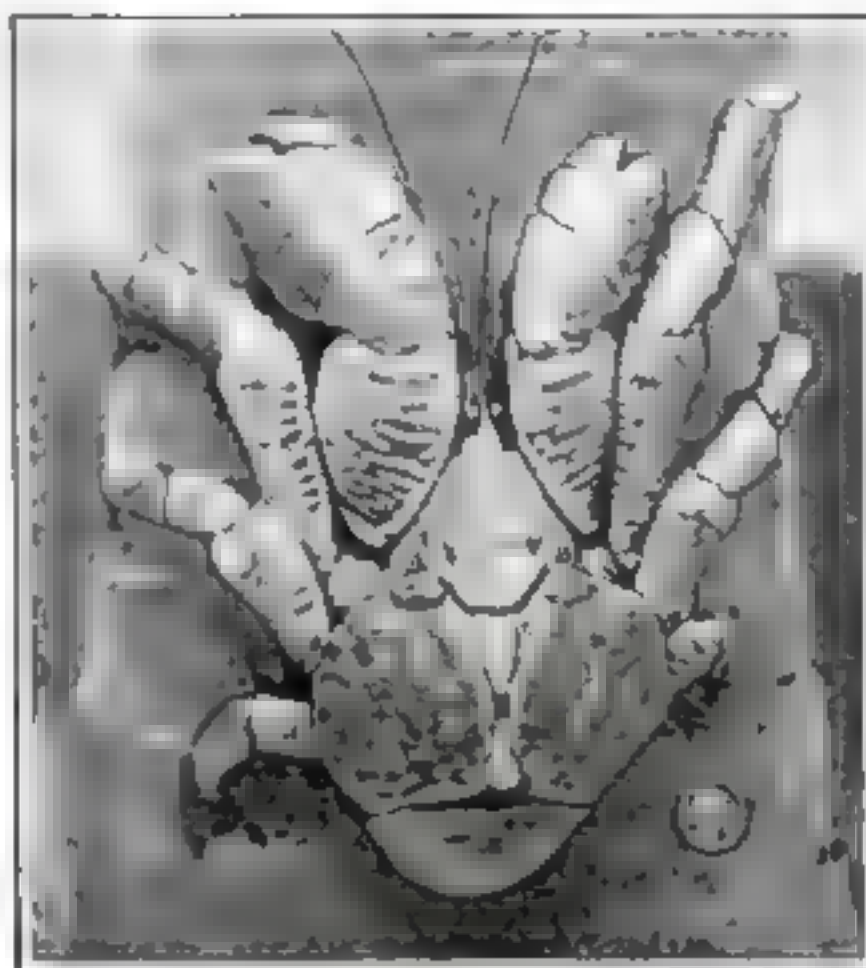
The Best Night Light for the Sick Room Is a Salted Candle

FOR a light to be burned all night, there is nothing superior to the old-fashioned candle especially if it is salted. The salting process consists simply in pouring a little salt into the hollow place around the wick after the candle has been lighted.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of the POPULAR SCIENCE MONTHLY is willing to answer questions.

The Robber Crab. It Prefers Coconuts, But Will Carry Away Anything

THE robber- or coconut-crab has been known for some centuries, but until lately doubts have existed as to whether or not they actually climb trees to reach the coconut. The photograph shown here, taken on Christmas Island, should dispel all uncertainty on the point. Although the giant creatures seem horrible as they crawl through the woods, they are easily frightened and scuttle off backwards at the slightest alarm.



The crab clings to the tree with the sharp points of its walking legs, scarcely using its large claws. It lives on coconuts and carrion.

The Machine-Gun Principle Applied to the Revolver

W. W. McHAVEN, of Birmingham, Alabama, feels that the revolver can be crossed with the machine-gun, with profit to the breed thus produced. He has taken the ordinary revolver principle, which involves a cylinder containing a number of chambers for cartridges and which is revolved by the action of the trigger or hammer, and for the fixed cylinder has substituted a chain of cartridge holders or chambers, to be made any length desired, so as to afford an increased number of shots without reloading. Each link of the chain carries a steel cartridge-holder, similar to the chamber in the cylinder of the revolver, and presumably heavy enough to stand a pressure of around ten thousand pounds per square inch, which is the pressure developed by the average revolver cartridge. The chain

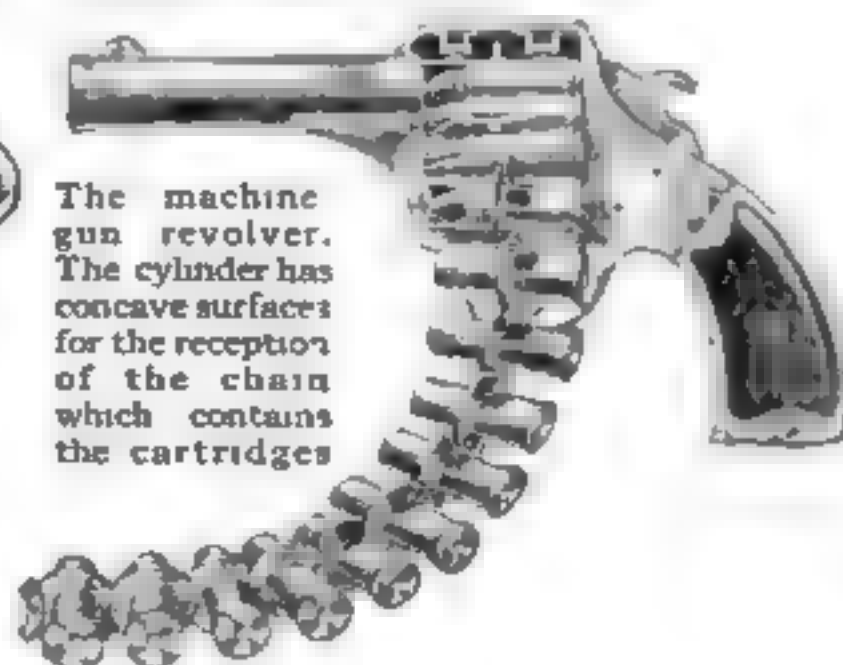
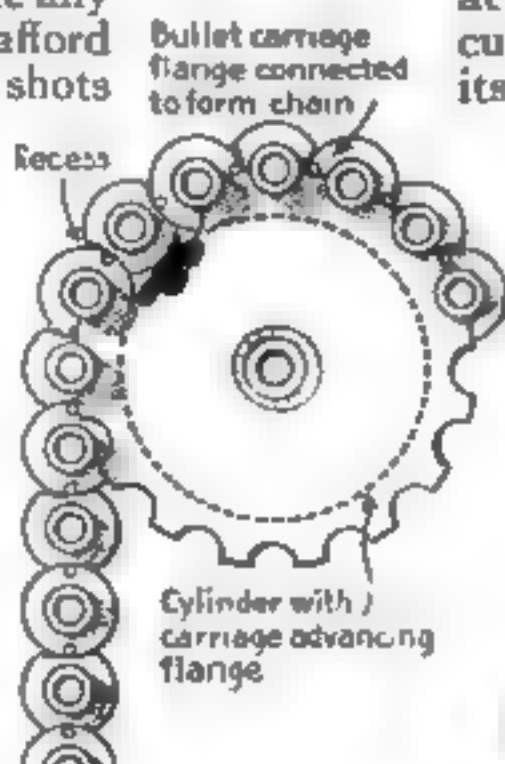
runs over sprocket-teeth affixed to the rear of a cylinder, which in turn is operated by the pressure of the finger on the trigger or hammer.

As the cylinder is revolved, the chain is brought up link by link, passing under rollers in the frame above the cylinder, the holders dropping into seats cut in the periphery of the cylinder, into which they are firmly held by the rollers. The shock of discharge is taken by the frame to the rear of the holder as it lies in position.

So here we have it, our cylinder of old-time days stretched out into the form of a chain, and that chain made any length you fancy.

You can have a little leather reel-case strapped to the right wrist, or else a flat box, *à la Maxim* gun, with the chain arranged therein—and the duration of your fire is limited only by the size of the box.

Scientifically speaking, the revolver is a rough-and-ready sort of weapon anyhow, with the cartridges carried in a cylinder separate from the barrel, with the bullet leaping a gap between the two, and with the powder gases sizzing out the passage 'twixt barrel and cylinder. Hence this chain invention is not so improbable as it sounds at first. But a revolver is not a very accurate weapon at best, and this one with its dangling chain seems clumsy.



The machine gun revolver. The cylinder has concave surfaces for the reception of the chain which contains the cartridges.

Eliminating the Periscope from the Submarine

THE terror of the German U-boats may be increased greatly since they have been constructed without periscopes. The sighting of the periscopes has saved many ships from destruction. Without a periscope the submarine may approach unseen. The new German submarines are built with two lenses, one on either side of the boat, co-acting with other lenses and reflectors. The disadvantage of this method of constructing submarines is that the boat must be much nearer the surface of the water than it would have to be with a periscope.



The pollen of the orchid is blown against the wires, and is held there and nourished by the dust

A Medical Battery No Bigger Than an Ordinary Flashlight

MOST medical batteries are as large as small-size suitcases and are therefore difficult to carry about. The battery illustrated is no bigger than a flashlight, yet it gives sufficient current to afford a shock and operate the vibrator. A miniature battery is provided in one of the handles or containers, and in the other are carried the switch, the starter, the pin which regulates the current and the vibrator.

This type of battery will be found useful for massage and wherever slight electrical stimulation is required.

It takes up very little space in the physician's hand-bag; or it can be carried in the pocket without inconvenience.



Orchids That Grow on Telegraph Wires Over the Streets

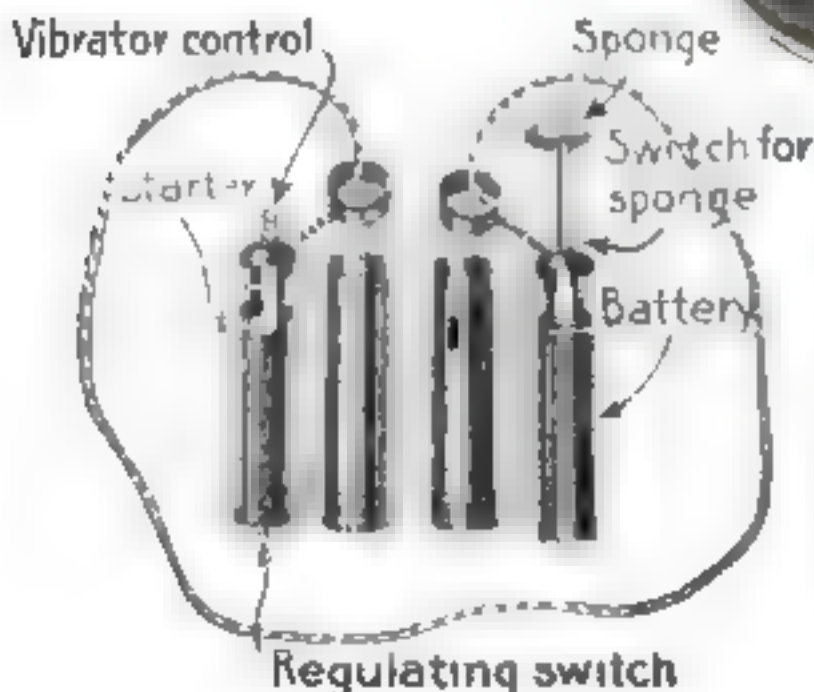
IN Porto Rico it is not unusual to have an orchid garden hanging over your house, suspended from telegraph wires. So heavy do the wires become when supporting the plants that it frequently becomes necessary for the telegraph companies to have them scraped to remove the growth.

Tropical orchids usually cling to the trunks or branches of large trees or ferns, where they produce aerial roots which absorb moisture from the atmosphere. Some are climbers and others grow head downwards. One very beautiful species grows in moss.

The one thing necessary for them is abundance of air. The plants shown in the photograph above are evidently satisfied with their supply.

Why Anthracite Coal Lands Differ in Price

THE prices of anthracite coal lands vary from \$200 to \$1,000 an acre, the smaller values being for lands containing relatively thin coal or practically exhausted veins. The medium values are paid for relatively small, unopened areas. The extreme values are for going concerns or for lands so located strategically that they have a special value for the purchaser.



The miniature battery gives sufficient current to operate the vibrator

Details of the battery showing the completeness of its equipment for medical purposes

Men Who Ought to Make Good Rifle Shots

Not the Kentucky "Moonshiner," not the "Bad Man" of the West, but the city dentist and the surveyor make the best shots

By Edward C. Crossman

NOW that learning to shoot the rifle will be the job of some million—mayhap five million—Americans, it is interesting to note the effect previous training in civil pursuits has on the ability to shoot the rifle straight and fast.

It does not make a romantic feature story, I know, but the cold fact remains that the peaceful gentlemen about the country, chiefly in the large cities where feuds are unknown, who have acquired the mastery of the .22-caliber rifle indoors, are far better shots than the legendary "bad men" of the West, who shoot on sight in the moving pictures.

Successful shooting depends primarily on the accurate laying of the sights shot after shot to keep the dispersion of the fire as small as possible; secondly on the ability to make muscles respond instantly and



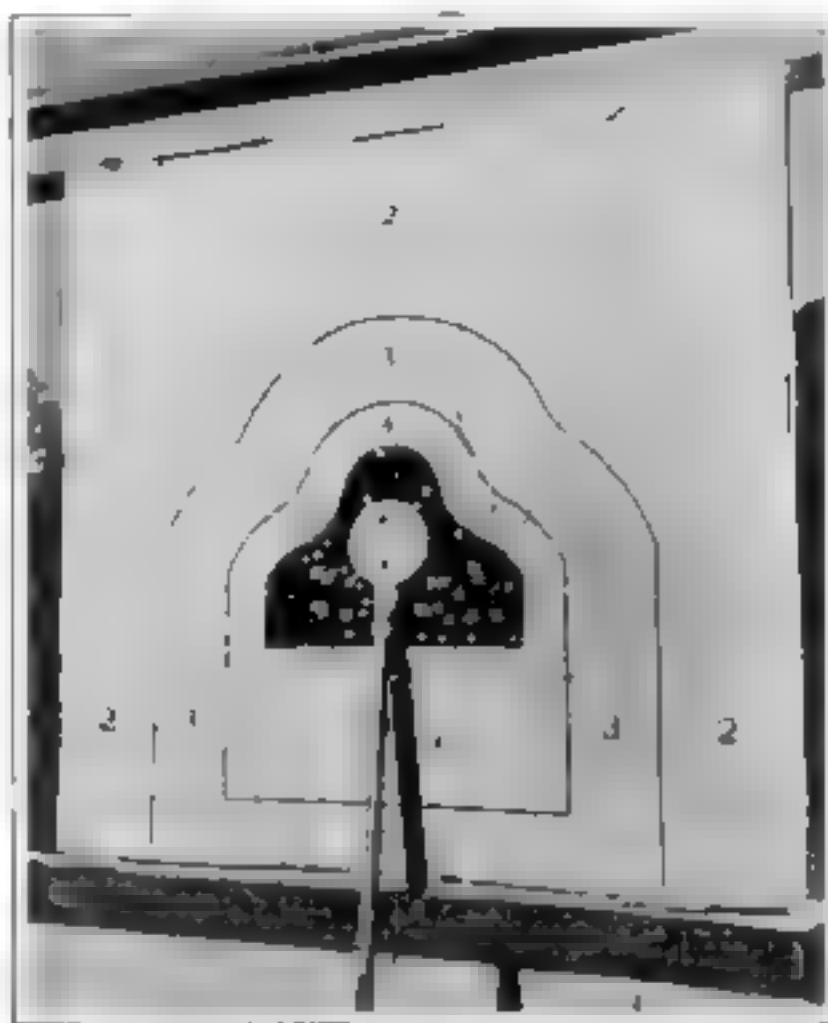
Successful shooting depends first of all on the accurate laying of the sights, shot after shot

smoothly to the commands of the nerves. Rifleman describe this more or less loosely

by the term "coördination." Particularly is this true in rapid-fire and snap shooting, where great accuracy and high speed are called for. A charge on your own trench calls for about fifteen rounds "rapid," according to my British friends; which means fifteen shots fired in about one minute. By this time the Teutons are either in the trench with you, preceded by a shower of hand grenades and more immediately by sharp bayonet, or else the gray ranks are broken, and the Teutons are on their way back—some of them.

What "Coördination" Means in Shooting

Now fifteen rounds rapid cannot even be fired out of the rifle by a man not skilled in its use, while fifteen rounds rapid fire in a minute with accuracy calls for perfect coördination—perfect command of the trigger-finger to the end that the shot may go



Sometimes the man who is stubborn enough to persevere gets the training of muscle and eye from ordinary target practice



The surveyor who can run out a series of accurate levels for twenty miles is not likely to get careless with rifle sights

instantly as the sights are alined on the running mark and yet go smoothly and accurately, not with the convulsive jerk on the trigger by which the untrained man fires the rifle hurriedly. This sort of shooting forms the greater part of rifle shooting in trench warfare, outside the highly specialized pursuit of sniping which calls for the highest skill of the trained shot.

Wherefore we find by theory, which is borne out by practice, that the men with highly trained hands and eyes make the best rifle shots, or else they make good rifle shots more quickly than the untrained, unskilled man from civilian life. Sometimes the man who is stubborn enough to persevere, gets the training of muscle and eye he needs with the rifle itself, and turns out to be a fine shot, but his path is always more difficult.

Surveyors make good rifle shots. One of the best rifle shots I ever saw, a man who practiced but little but still shot on the American Pan-American rifle team of 1913, was a surveyor. Considering the amount of rifle shooting he did, he came near being under the mythical classification, "born rifle shots," but a study of his work in civil life removed the time-worn legend as explanation for his skill. The surveyor possesses to a high degree the ability to aline the sights accurately and to repeat the process from shot to shot. Carefulness is acquired by him by long practice. The man who can run out a series of levels for twenty miles for a canal is not likely to get

careless with rifle sights; the matter of care is a habit. Moreover, the use of the transit and the tape and the stadia rod make for delicacy of touch and training of the muscles.



Here is the trained eye, the trained hand and the perfect command over the muscles which the rifleman needs

the various electrical dental instruments during their business hours. Here is the trained eye, the trained hand, and the perfect command over the muscles that have to do with alining the rifle and letting it off. No man able to work neatly around the exposed nerve in the back of a tooth is lacking in hand-training and coordination. No man who can cut skillfully around a pulsating tube carrying the life stream is going to be bothered long in mastering the quick but smooth release of the trigger when the eye says that the mark is perched on the front sight.

The mechanic (the skilled mechanic, not the butcher) has the advantage over the man who has used the pick and shovel to make his daily bread. Here again is eye training, the careful use of accurate tools, and the ability to make the hands do what the mind tells them to do.

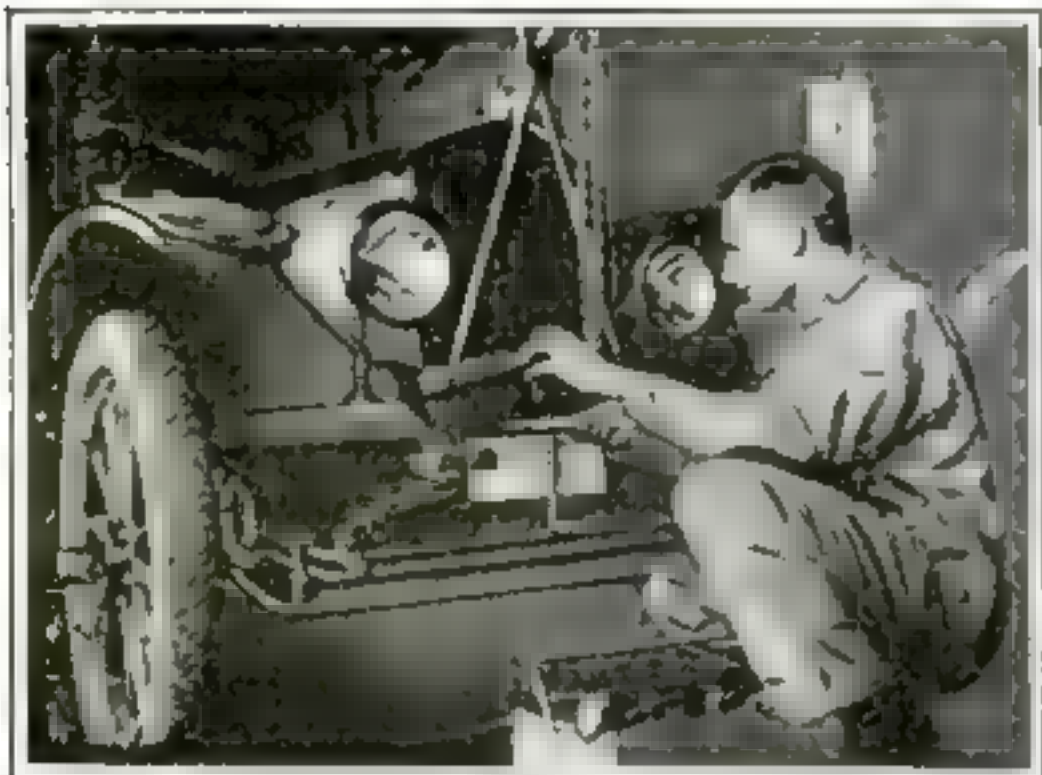
One of the best "natural born" woman pistol shots of my acquaintance was a girl who had done china painting for years and who had acquired the smooth, certain



Some of the finest shots in the army were formerly dentists

Why the Dentist and the Surgeon Ought to Be Crack Shots

Surgeons and dentists make fine rifle shots. More of them than of any other one profession, are found in the ranks of skilled marksmen and some of the finest shots in the country wield scalpel or



The skilled mechanic or electrician has the advantage over the pick-and-shovel man in rifle shooting

command of the hands by her work that made her good with the pistol the first day.

The trained gymnast has the edge on the untrained man. He may require a little time to get used to sighting accurately, but he has command of his body, he has learned to make any set of muscles respond when desired.

The man of untrained hands, the "working man," regardless of his hard biceps and triceps and deltoid, will have more trouble mastering rifle shooting in all its phases. Such men find little trouble in holding the rifle like a rock in the prone position by the aid of the sling, because muscular strength and a little knack in sling adjustment are all that are required. But when it comes to rapid fire and snap shooting, they lack the command of eye and nerve and muscle. This is the story in theory.

The way to learn how to shoot the rifle is to shoot the rifle—doing the preliminary work with the empty gun, and then with the humble .22, which shows bullet strike, but does not cover up by heavy recoil the sin of "yanking the trigger," which is undoubtedly the cardinal fault of the beginner.

How About that Third Cup of Coffee for Breakfast

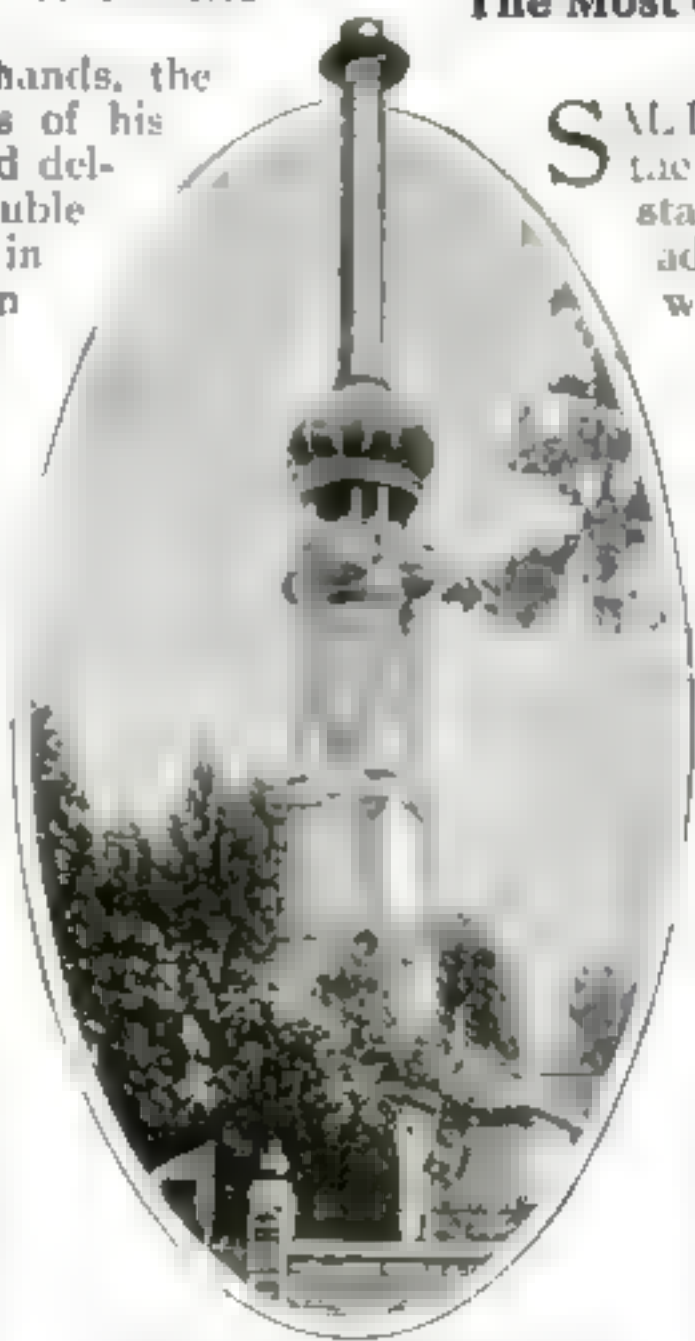
IN the matter of cutting down the daily food consumption to a reasonable minimum, why not begin with coffee? Although coffee is a true stimulant, it is essentially a drug and has in itself no food value. Its effects in the main are due to an alkaloid, caffeine, which, it is believed, is a heart stimulant.

In a sound, healthy individual, doses of caffeine equivalent to that obtained from one cup of strong coffee produce no noticeable effect except a slight nervousness. Doses equivalent to one and one-half cups produce marked unsteadiness in muscular and mental work.

Doses sufficient to produce any real stimulative effect raise the blood pressure, sometimes dangerously, and stimulate the action of the kidneys in a manner considered by physicians to be harmful.

The Most Ornamental Smokestack in the World

SALT LAKE CITY has perhaps the most ornamental smokestack in the world. Since it adorns the top of a building in which smokeless fuel is burned, no one unacquainted with the plant and the purpose of the stack would be likely to suspect its function. It resembles the minaret of some Turkish mosque, but it belongs to a power-house. It stands six feet high, the lower half being of stone construction with the smoke vent through the center. The upper half is extended as a tubular steel chimney surmounting a crown-shaped dome of metal. This dome serves as a roof for the observation platform for visitors, greatly adding to the appearance of the tower and completing the illusion. The entire city and landscape for miles around can be seen from the platform.



A minaret of a Turkish mosque? No; a power-house smokestack in beautiful Salt Lake City

Hauling a Seven-Ton Truck Out of the Mud

A special wrecking truck did the trick after four other trucks working together had failed

A MIRE D truck had backed off the edge of a back-fill pile at a swamp and half buried itself in the mud. Four other trucks working as a unit arrived on the scene and broke a seven-eighths-inch chain in trying to extricate it. Then a special wrecking truck maintained by one of the New York city service stations appeared. It pulled the mired seven-ton truck out of the marsh and up a ten-foot embankment.

The wrecker, which consists of a conventional truck chassis with a worm-driven winch and crane boom mounted in place of the body, backed up to the edge of the pile, had its rear wheels chocked and pulled the mired truck out alone by means of a block and tackle.

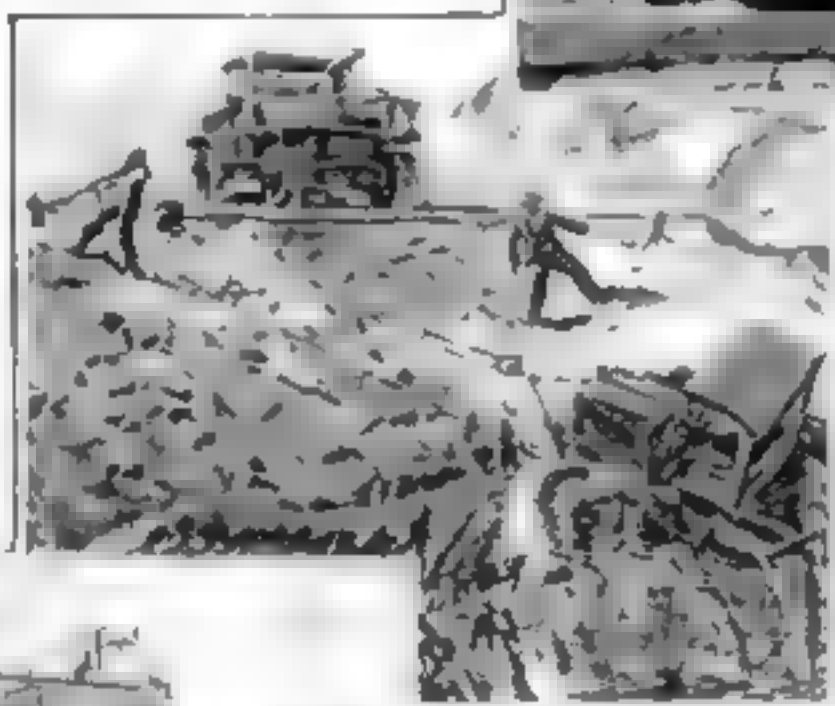
One block was attached to a chain drawn around the front spring horns of the mired truck and the other to a bar anchor driven in the ground, the free end of the block rope being attached to the chain cable running over the truck crane and then to the winch drum.

the free ends were snubbed around two other anchors.

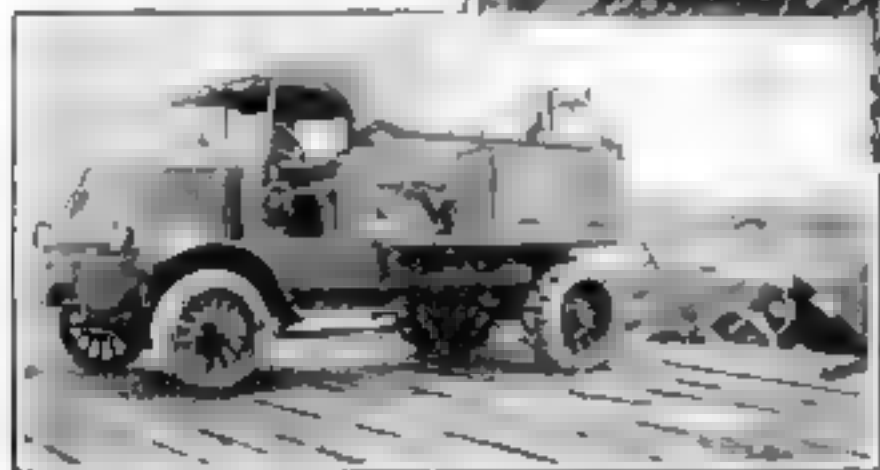
In this way the mired truck was hauled up the embankment without further delay and without subjecting it to further damage. The entire operation took up less than an hour—after the wrecker was put on the job.



The seven-ton truck backed off the edge of a swamp and half-buried itself in the mud



At left: Attaching the chain to the mired truck so that the engine can draw it up



Pulling the mired truck up the embankment. Note the curved blocks behind the wrecker's rear wheels to prevent it from slipping

The truck engine was then started, the winch revolved and the cable wound up, thus bringing the truck out of its marshy resting place.

As a precautionary measure to keep the mired truck from twisting around, a second rope was tied to each of its rear wheels and

Trees in the Forest One Week— Houses the Next

WHO would think that trees growing in the forest could be converted into houses within the space of a week? Yet, that is exactly what happened in the cantonment at Louisville, Kentucky. The administration buildings were constructed from lumber which was felled in a Mississippi pine forest on Saturday, kiln dried on Sunday, transported on Monday and Tuesday, delivered at Louisville on Wednesday and converted into houses on Thursday and Friday. On Saturday, just one week from the day the trees were cut down, the houses were completed.

Dry Your Fruit and Vegetables at Home with an Evaporator

THE evaporator method of canning fruits and vegetables takes from one and one half to five hours. Peas, corn, beans, cherries and strawberries can be dried on the evaporator in from two to three hours. Apples cut with parer, corer, and slicer will dry in one and one half hours. The water chamber is filled about half full of water to generate steam, and heat the surface upon which the fruit and vegetables are placed.

Or you may accomplish the same result by slicing your fruit and vegetables and forcing air at room temperature across them with an electric fan. This process is slower than the one described above, but it is equally as successful.

A home-made evaporator can be made similar to the one shown. Five or more racks of wood with wire bottoms can be placed on top of each other and the wind forced against them.

Business Is Booming in War Horses and Mules

DESPITE the fact that the great war is being waged largely by means of mechanical devices, horses and mules have played an important part in it. Up to the present time 920,000 horses and 330,000 mules have been sent to the theater of war from the United States. The value of the horses which have been exported is \$194,000,000 and of mules \$66,000,000.

The number of mules being sent to the war is increasing from year to year. The sagacity of the mule makes him very valuable in war work. Most of the horses and mules shipped from this country go directly to France. Others are sent to Great Britain and Canada and a few to some of the other European countries.

A curious feature of the great volume of business which has been done in horses and mules is the fact that the extraordinary demand made by the war has not caused the prices of these animals to rise. Indeed, horses sold at an average of \$109 per head on January 1st, 1914, and at \$103 per head on

January 1, 1917. This is the effect the war has had on the prices of farm animals.

There are in the world 100,000,000 horses, one fifth of which are in the United States, which accounts for the great

number of horses this country has exported since the war began. Russia has 30,000,000 horses while the United States numbers its available horses at 22,000,000.



Steam is generated in a water chamber and heats the pan in which the fruit is placed

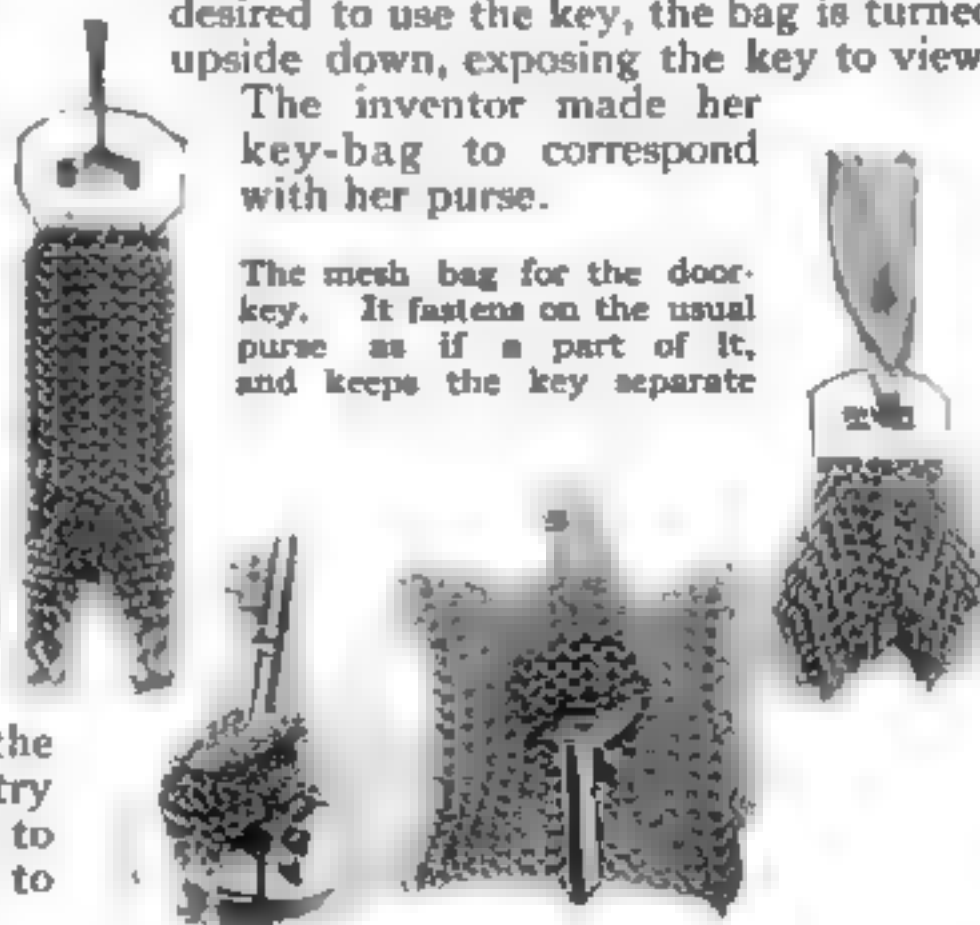
Carry Your House Key in Its Own Private Mesh Bag

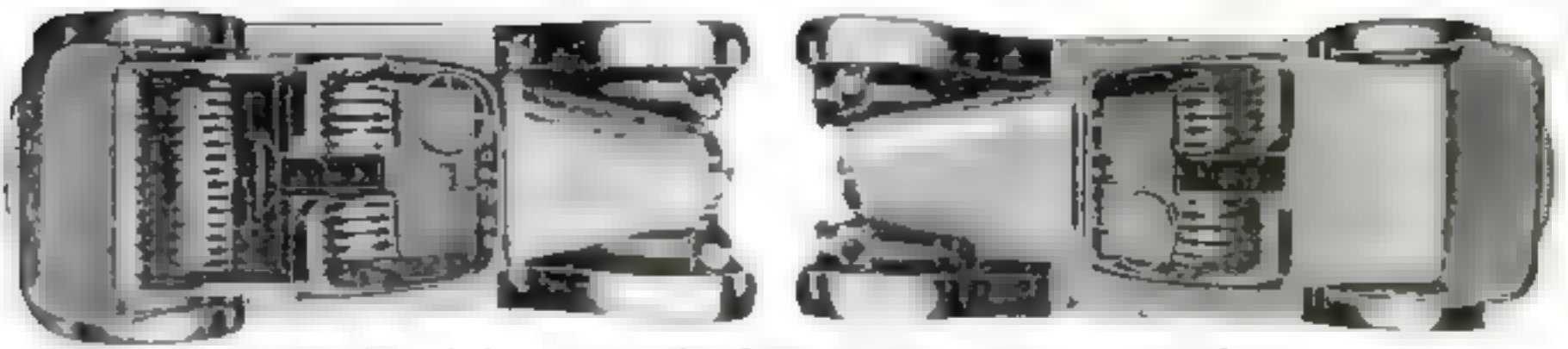
A MESH bag for the door key has been invented by Mrs. Olga Berghorn, of Jersey City, N. J., so that the key need not get lost among the contents of the pocket book.

The bag may be made of any size to conform with any shape of key. When it is desired to use the key, the bag is turned upside down, exposing the key to view.

The inventor made her key-bag to correspond with her purse.

The mesh bag for the door-key. It fastens on the usual purse as if a part of it, and keeps the key separate





At the left of the picture the five-passenger arrangement is shown
At right two transverse hinged covers completely conceal the rear seat

Changing a Roadster Into a Five-Passenger Car

THE automobile body shown in the accompanying illustrations is a real novelty. You can convert it from a five-passenger touring model into a speedy-looking two-seated roadster or vice versa in a few minutes' time. It differs from the ordinary type of convertible bodies, in that it looks equally well in either form instead of pleasing in one position and poor in the other. When in the roadster form the full-width rear seat of the touring car is completely hidden by two transverse hinged covers which provide an unbroken rear deck line.

The two hinged covers are attached to patented sliding hinges as shown. The forward cover is upholstered on the bottom and is swung backward and turned completely over to form the cushion of the rear seat. Similarly the rear cover, also upholstered on the bottom, is swung around as shown to form the back of the rear seat.



The forward cover when swung back forms the cushion of the rear seat. Similarly the rear cover forms the back

Playing Patriotic Tunes on the Air-Brake

A CHICAGO motorman has discovered that an air-brake is a musical instrument. He makes his air-brake give forth "sweet sounds" (he is responsible for the "sweet," not we) by placing his finger over the exhaust. The notes become more shrill when he presses hard. He can play simple melodies. In the interests of patriotism he is now learning how to play the Star-Spangled Banner in this way.

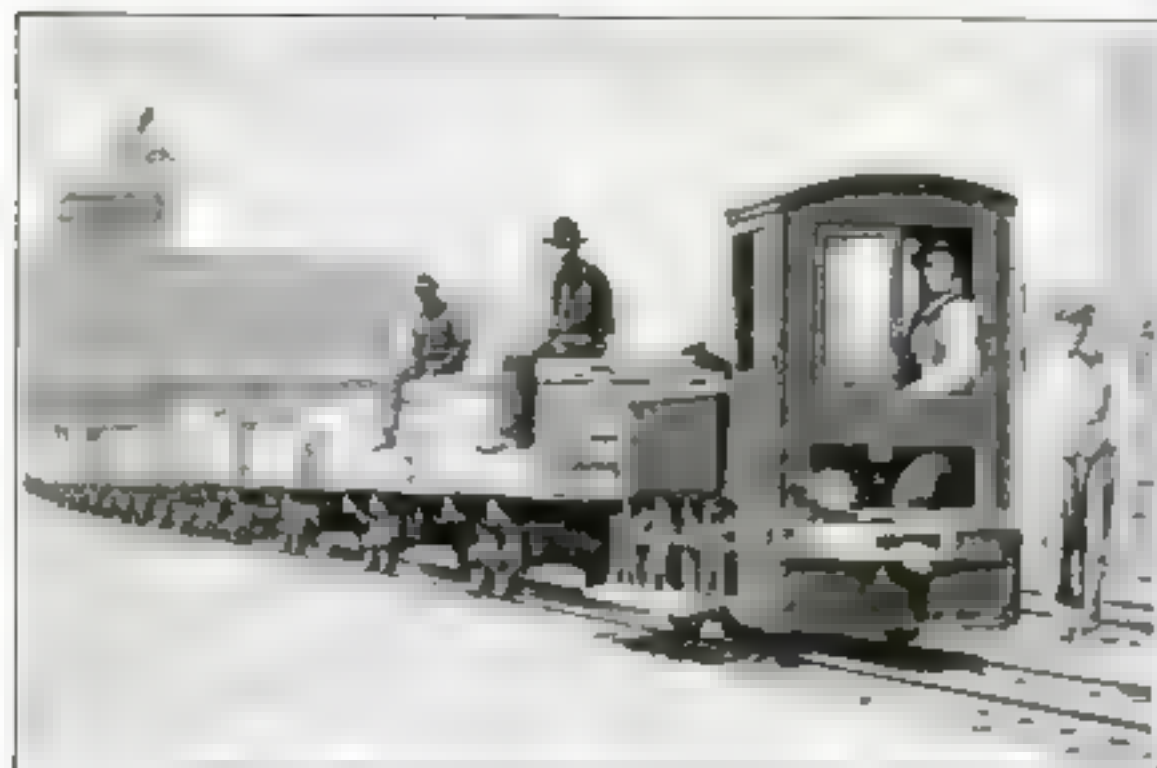
How Plants Accommodate Themselves to the Climate

THAT plants breathe and absorb moisture is a well known fact. But that some of them breathe faster at intervals in order to generate heat is not so generally known. The soldanellas, which may be found in the lower Alps, are a good example.

These delicate bell-shaped flowers grow up through solid crusts of ice, looking as if they had been stuck there by hand. When the snow covering is very deep and the stalks are not able to reach the surface, the plant immediately sets to work generating enough heat to melt the snow immediately surrounding it, making a little crater-like bowl in which the purple flowers look

like bouquets held in crystal vases.

Going to the other extreme, we find the Mexican cactus reducing its temperature and that of the sand touching it, and keeping comfortably cool even when the heat in the rocks and sand is great enough to blister the hands and feet of the natives. If the cactus is cut and a thermometer is inserted the temperature of the plant will be found to be at least thirty degrees lower than the surrounding atmosphere. Just how this is accomplished is one of the secrets which Nature still keeps. It is perhaps partly because the thick leathery skin of the cactus, which is usually covered with hairs and spines, retains the moisture gathered from the infrequent rains and heavy night-dews, drawing it into the interior of the skin and keeping it cool by protecting it from the sun, thus furnishing its own refrigerating system.



Small as this locomotive seems it can pull a train of eighteen cars, each loaded with $3\frac{1}{4}$ tons of lumber

Diminutive Electric Locomotives Used in a Lumber-Mill Yard

SMALL electric locomotives of a kind every youthful mechanic in the country would yearn to run are being used by a large western lumber mill to transport raw and finished lumber about its plant. The locomotives run on a three-foot track, and there are upwards of forty miles of it scattered around the big mill.

The locomotives for this service are really standard mine locomotives persuaded to run on top of the ground instead of under it, and disguised a bit by the erection of a steel cab at one end. Regular mine locomotives cannot as a rule afford this luxury since the low-hanging roofs of mine tunnels would in all probability scrape it off.

Storage batteries carried on the locomotives themselves furnish the power. During the night when the machines are off duty the batteries receive the charge that is to last them through the next day. The locomotives are more powerful than their diminutive size would lead one to expect. On a level stretch each can readily pull a train of eighteen small cars loaded with about three and a half tons of lumber each. Unusually long

couplings consisting of heavy rods seven or eight feet in length with a hook at each end, fasten into the coupler bars of each car, resulting in about a three-yard spacing between successive cars when they are connected.

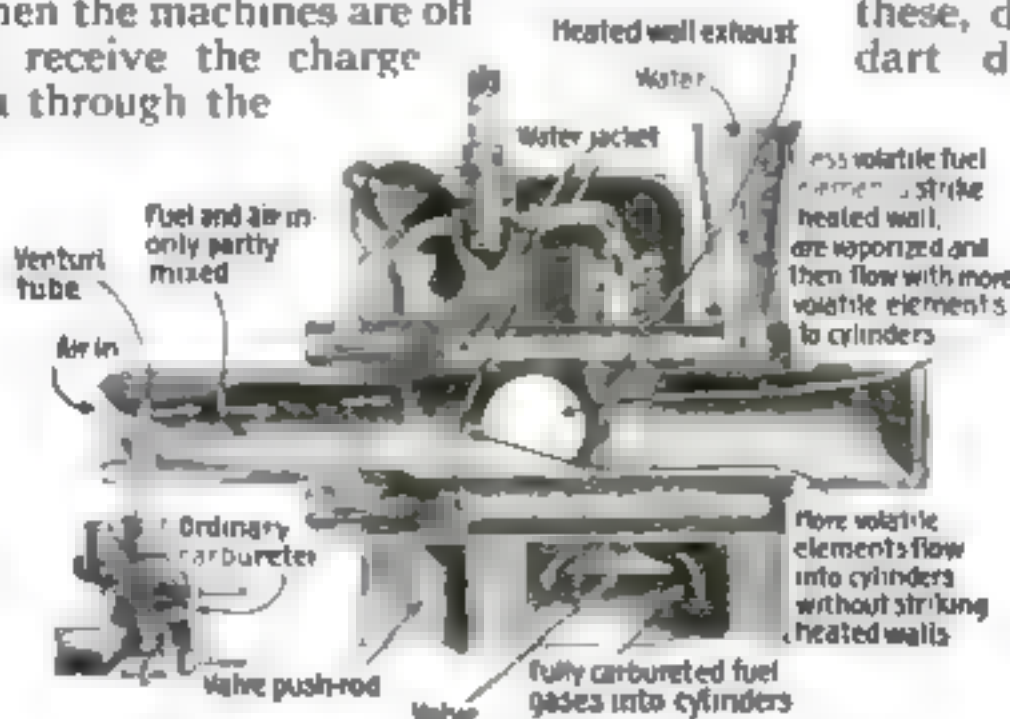
This spacing is necessary because the lumber being transported overhangs each car body to so great a degree. The three locomotives, small though they look, do work that would otherwise require more than twenty horses. Moreover they don't eat any hay when off duty.

Getting More Mileage Out of Gasoline with the Hot-Point Manifold

ONE of the most successful means worked out for giving an increased mileage per gallon of gasoline in automobiles since the fuel problem became so acute, is the hot-point manifold. The hot-point manifold consists of a tube, made a part of the cylinder head in the case shown, which is water-jacketed throughout its entire surface, except the ends and a wall on the inner side at the middle.

The incoming air passing through the Venturi of the carbureter picks up a suitable amount of fuel. With the present low grade of fuel, which is part kerosene and part gasoline, the heavy kerosene elements do not volatilize or change into gas as readily as the gasoline constituents. The kerosene portion enters the manifold in globules or small drops, and these, due to their weight, dart directly across the

manifold and impinge on the hot surface. From contact with the heated metallic surface they are thrown off in gas and mix readily with the ingoing air and lighter gasoline fuel elements. The hot point of the manifold prevents recondensation.



The hot-point manifold is near enough to the cylinders to prevent recondensation of kerosene



The lion was lifted out of the top of his cage with grappling hooks and a derrick

Two boards were shifted back and forth to give the lion the appearance of running

Harnessing a Fighting Lion for the Films

THE photographs above were taken during the filming of an-adventure-in-the-jungle photo play, when a lion was to be pictured running. The "jungle" was mere painted canvas, but the lion—he was very much the real thing! With mighty struggles and protests, he was lifted by a derrick right over the top of his cage and on to a stationary, split platform on the stage. His feet rested upon two boards which were alternately given a back and forward motion. The result was a furious struggling lion.

To hold the animal steady he was strapped to this heavy iron support on the stationary platform

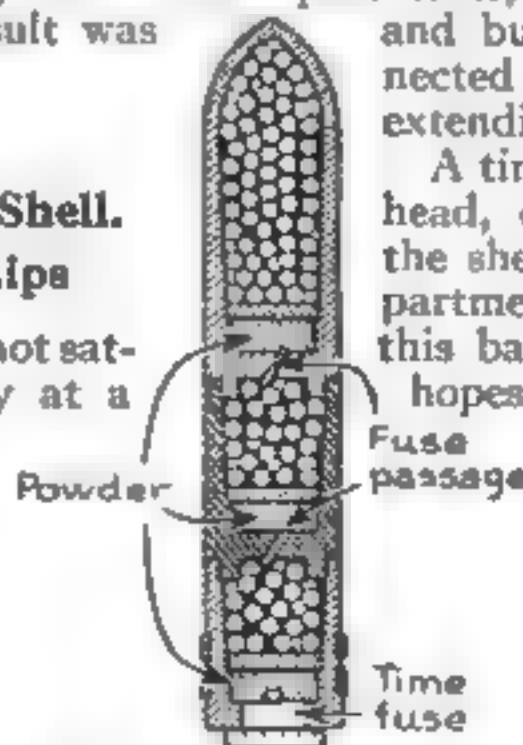
the third may find the mark. Each compartment charge gives off a different colored light for the information of the gunner, who knows the time interval between the charges and the time for which the first compartment is set to burst. By comparing the position of the red or blue or white flare with the position of the airship, the gunner corrects his range.

This performance is made possible by a shell having three separate and heavy compartments, each with its load of shrapnel and bursting charge. They are connected only by a small fuse passage extending from one to the other.

A time fuse which is carried in the head, connected by a tube through the shell with the charge in the compartment at the base of the shell, fires this base charge at what the gunner hopes is the psychological moment for obtaining the desired result. But if this happens to be a poor choice of time, the fuse crawls up to compartment two, and sets off that also, with its different colored light. If nothing decisive happens then, the gunner finally lets the third charge go in the shell head.

Three Shots with a Single Shell. It's Intended for Airships

A KIND-FACED Britisher, not satisfied with having one try at a Zeppelin or an airplane with each shot from an anti-aircraft gun, has designed and patented a progressively exploding shell which has three exploder charges in three separate compartments, arranged to burst at different time intervals. If the first explosion is too early the second or



The three compartments of the shell are connected by a tube with the charge

Announcing the Election Returns by Telephone

NEWSPAPERS, clubs and private individuals want the election returns while they are coming in. To get them they use the telephone.

The headquarters of a telephone company is thus called upon to act as a public information bureau. The telephone companies have responded graciously, and each election sees them organizing a huge force of men who collect and distribute the returns to every subscriber who calls up, whether he be in the center of a large city or in a small country town.

This task, especially for the companies within great centers of population, is enormous. A staff of collectors at the political and at the polling headquarters all over the entire country constantly report the latest counts over direct wires leading to the tabulating room. Here a corps of men compile the statistics as they come in. Other men arrange the returns into convenient bulletins.

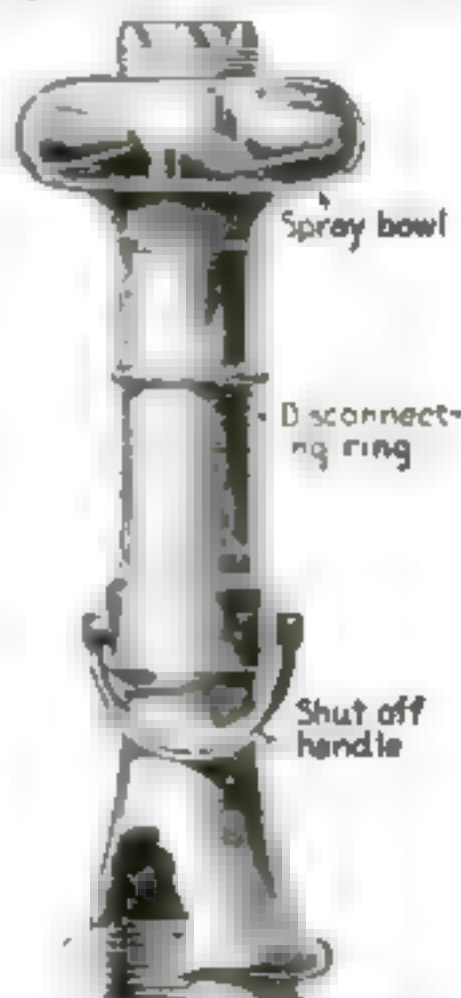
Once edited, the bulletins are typewritten upon a lantern slide for the sending room. A projection machine throws the bulletin upon a sheet. Each operator immediately telephones the information thus projected to a group of sub-sending stations. These in turn relay it to sub-sub-sending stations.

How the Fireman's Cellar Shut-Off Nozzle Originated

BECAUSE John Hurie, a fireman, was ambitious to earn more money to secure comforts for his sick wife, he was constantly on the look-out for "Opportunity" (Capital O). He found it. It happened at a fire in a building where the cellar was filled with bales of tarred hemp which had caught fire. Owing to the dense smoke the only way the firemen could get into the cellar was by chopping a hole in the floor and using a cellar nozzle which threw nine thirty-foot streams of water.

There was just one hitch on the job. A second line of hose had to be used because the cellar nozzle had no shut-off and could not be used unless the engine or the hydrant was shut down. This necessitated delay and waste of water. So Hurie set to work to plan out a cellar nozzle with a shut-off. He finally worked out the one

shown in the illustration, which can be used without a separate line of hose and does not necessitate shutting down the engine. The nozzle throws a powerful circular spray and has a shut-off handle by means of which the water from the hose can be shut off instantly so that the nozzle can be changed,



The shut-off handle makes it possible to change the nozzle without waste of water



Reports from all over the country are thrown on a sheet in the front of the sending room. The operators distribute it in bulletin form to various sub- and sub-sub-sending stations

San Salvador's Terrible Quake

In a twinkling of an eye a beautiful, flourishing city became a rubbish heap

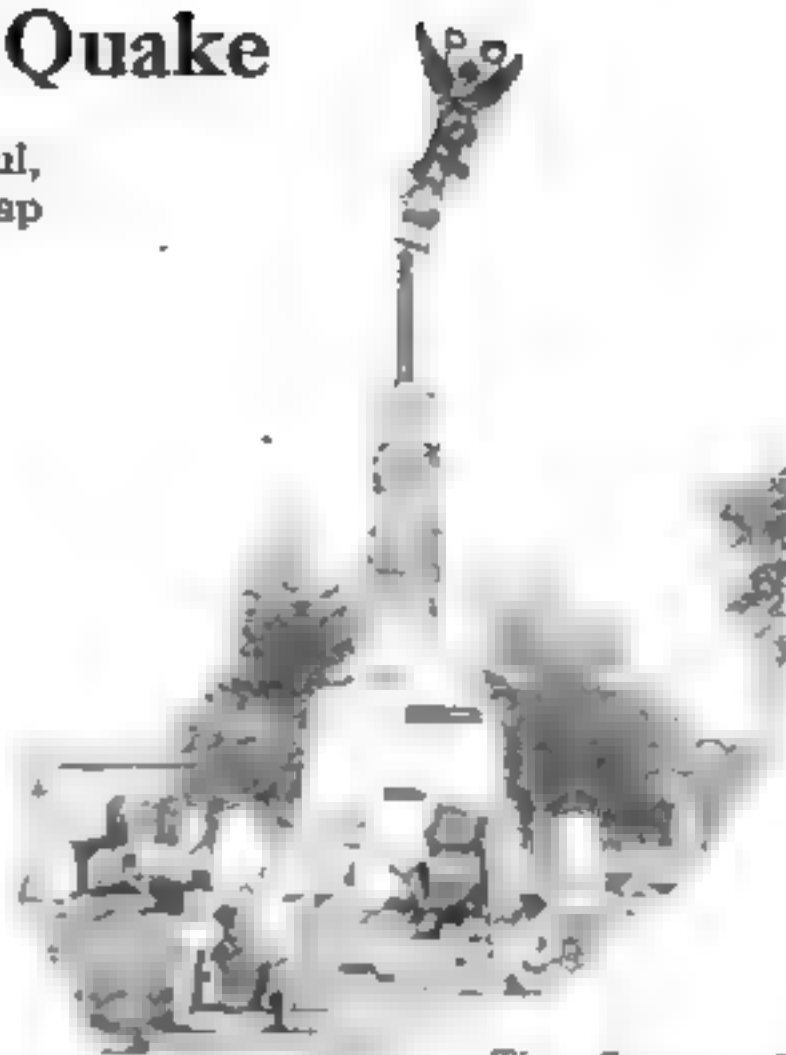
By M. Toeplitz

ON the 7th of June, 1917, seven minutes before seven o'clock, the first indication of the coming catastrophe was felt. Very soon after the first rumbling the mortar crumbled from the walls, chairs and tables started to dance and the electric lights went out. The upper stairs of our hotel crashed down and we were barely able to reach the street. Here I was swept along by a crazed mob bound for the park. People fell on their knees and prayed aloud for mercy.

Houses collapsed on all sides like paper boxes and the ground undulated like the sea. The statue of Victory on the Plaza was twisted about oddly, while the shocks increased in strength and frequency. The church towers of the cathedral seemed to be shaken by a gigantic hand and the huge cross of the right steeple crashed down, shattering the stone saints below. All the bells clanged uncannily.

Of all high edifices the concrete building of the Teatro Colon alone remained unscathed. From the Plazuela del Teatro opposite the Teatro Nacional there was a wonderful view of the volcano. The last shock had ripped open the mountain side, and the sky had turned scarlet. At the same time the acids in the Pharmacia de la Cruz Roja exploded, and soon the entire section was a sea of flames.

Towards 11 o'clock it began to rain ashes, first in a fine shower and then in a thick downpour so that walking was most difficult. Half



The Statue of Victory in a very Pisa-like attitude

an hour later real rain fell, and everything became covered with a horrible sticky mud.

During the 8th and 9th of June the population suffered greatly from lack of food and water. The shocks continued and terrible thunderstorms broke loose. Torrents of water entered the cracks in the broken walls and finished the destruction.

The Government took charge from the first and deserves great praise for promptness and efficiency. Martial law was declared and in a short time perfect order was restored.

For many miles the railroad tracks to Ajacuntal were covered with lava so that traffic was blocked for many weeks.

Thousands left the city, but many camped on the ruins.



For many miles the railroad tracks were covered with lava, thus completely shutting off the city from the rest of the world



The built-in kitchen cabinet extends from ceiling to floor, with a glass-covered table section in the center

The Kitchen Cabinet Up-to-Date. It Utilizes the Whole Side Wall

EFFICIENCY in the kitchen, almost more than anywhere else, demands conservation of space, so that steps are saved from table to stove or cupboard and back. In the kitchen cabinet illustrated above, the kitchen table is in one with the cupboard. In fact, it is the top board of the bottom section of the cabinet.

The top section consists of a closet for dishes, jars and cooking utensils. It extends clear up to the ceiling, the top shelves being occupied by the articles not frequently required. The closet underneath the table section is fitted with three semi-circular bins

which slide in grooves so that they open out and at a slight angle. Under the bins is a storage space in which the larger and heavier pots and preserving kettles are kept.

The table section is a special feature. The board top is covered over with oilcloth and over this a glass cover is fitted. This makes it easy to keep spotlessly clean. At the same time, it may be used as a bread board on which dough may be kneaded, or for any other purpose for which separate trays or boards would have to be used.

This Furnace Practically Takes Care of Itself

A HEATER which serves equally well for steam, vapor, or hot water heating systems has a magazine and sloping grates, so that it requires little care. By filling the magazine and removing the ashes from the sloping grates the heater can be made to run itself with attention only once or twice a day. The coal in the magazine is surrounded by a water-jacket so that the coal inside is not turned into coke before reaching the burning portion. This is the special feature of the device in which it differs from other types of self-feeding heaters. The coal drops gradually into the fire-bed.

Because of its automatic action the heater is especially adapted for use in households where the fire must go for a long time without attention, but it is also useful in large buildings where interruption of the janitor at his other duties is undesirable. On account of the simplicity of its construction, the heater for the private house can be operated by a mere novice and the fire kept going continually without employing a regular "furnace man."

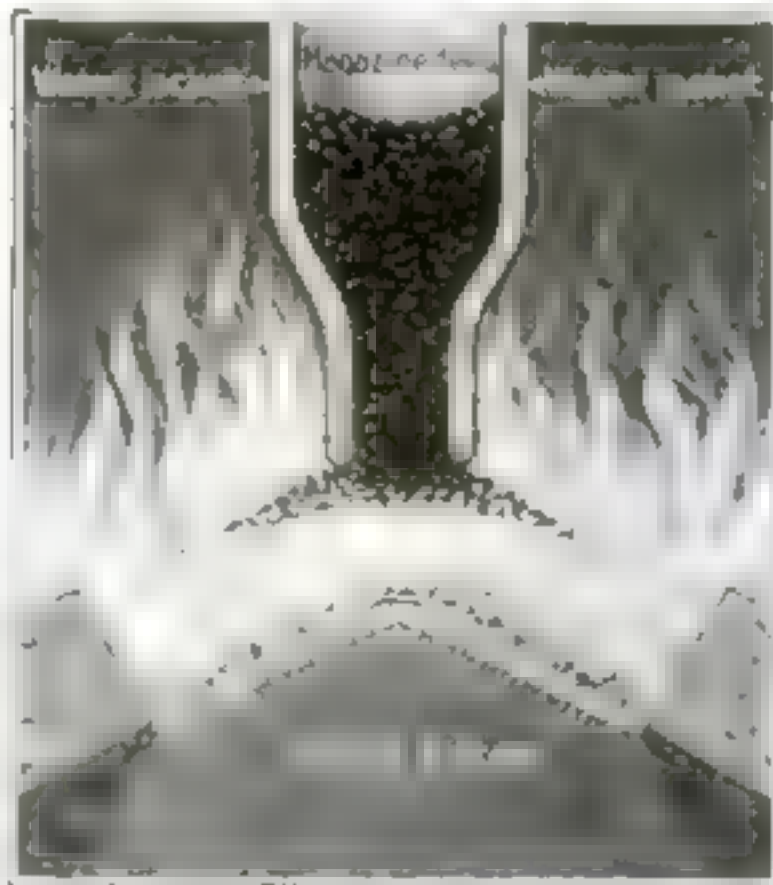


Diagram of the automatic heater which serves equally well for either large or small steam, vapor, or hot water systems

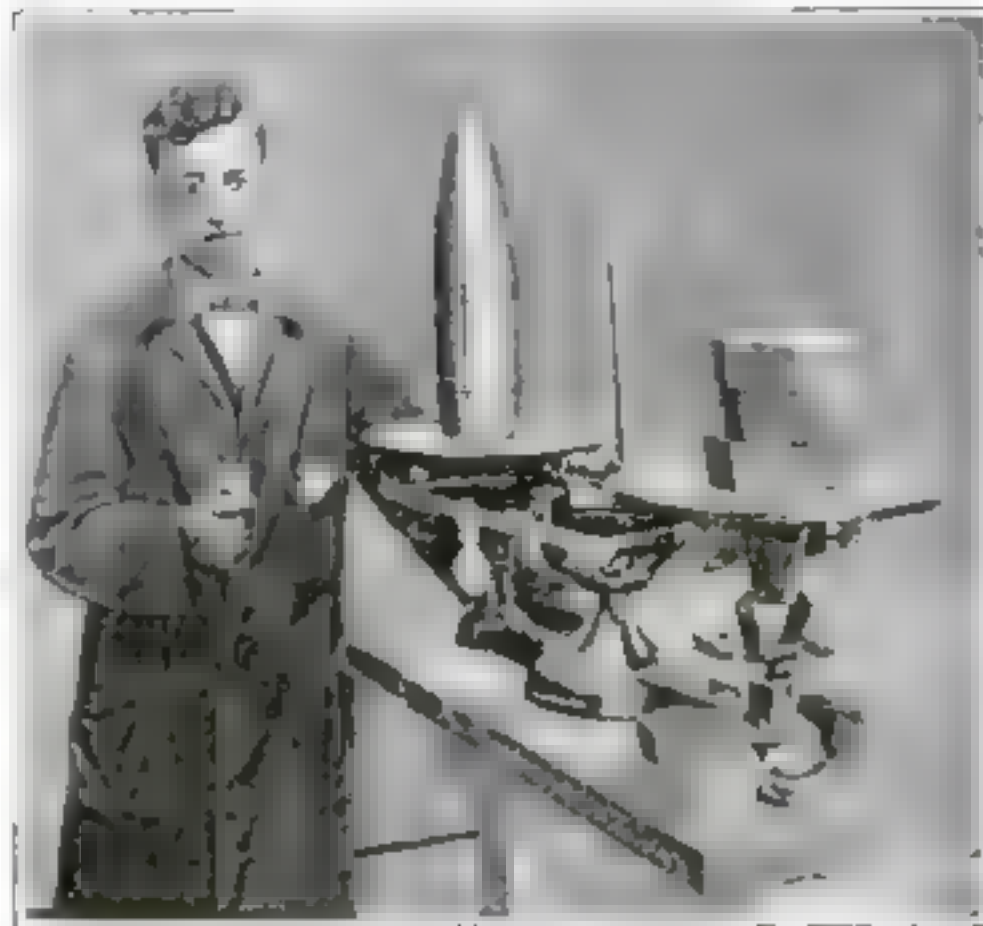
Will a Projectile Fly True?

The uniformity in the balance of the shell determines its accuracy and ultimate destructiveness

By Reginald Trautschold, M. E.

IF a projectile is to strike its mark miles from the muzzle of the gun from which it is fired, more is required than accurate range finding, accurate gaging of the propelling charge and accurate aiming. The projectile must be well balanced. Otherwise it can not be counted upon to fly true. In other words, the projectile must weigh just so much; its dimensions must not vary; and it must be properly balanced, both about its axis and lengthwise. Accurate tests must therefore be made to discover whether a certain, very slight allowable variation (human fallibility cannot be entirely overcome) has been exceeded.

In France, the shell to be tested for balance about its axis is laid at right angles across two level and parallel steel bars. Since the weight of the projectile can never be evenly distributed, the shell will obviously roll until it comes to rest, heavy side down. Is it too unbalanced? To find out, a contrivance known as an "eccentricity weight" is clamped to the base of the shell. This eccentricity weight, as its name implies, is not evenly balanced about its center; one end is heavier than the other.



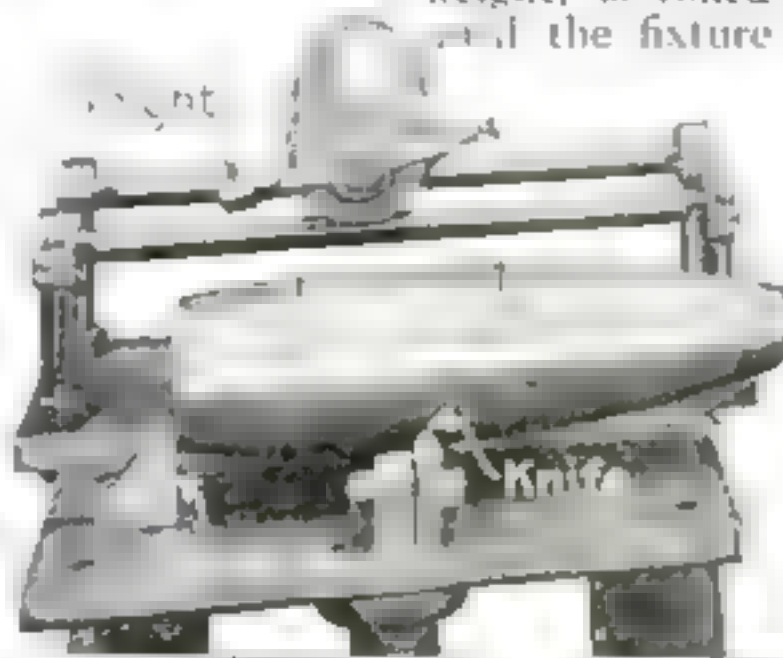
Testing the French 120 m.m. shell for weight and ballistic properties. The man is holding a small weight showing the allowable tolerance in weight



A shell balanced on the knife edges of the weighing apparatus to ascertain the point of its lengthwise balance

The exact weight of this fixture is known and also the exact distance from its center of the point at which it would balance if laid across a knife-edge. The fixture is clamped to the base of the shell, perpendicularly, with its heavier end *up*, i. e., opposite the heavier side of the shell.

The shell, with attached eccentricity weight, is rolled along the parallel bars and the fixture is horizontal, and then released. Should the shell and weight remain in this position, the surplus weight on the heavier side of the shell exactly balances the offset weight of the fixture. Such a state of equilibrium rarely occurs. The shell usually rocks in one direction or the other until a position of exact balance is found, when it comes to rest. Should the weighted end now point toward the



An eccentricity weight is attached to the shell on the bars. If the weighted end points downward when it comes to rest the shell is approved

ground, no matter how obliquely; the tester knows that the eccentricity of the fixture, due to its unbalanced distribution of weight, is greater than that of the shell, due to its uneven distribution of metal about its axis. Should it, however, point upward, the reverse is true.

The weight and offset of the eccentricity weight are proportioned to agree with the maximum allowable variation from perfect balance of the shell, so that, if the weighted end of the fixture points upward the shell fails to pass the test, while if the weighted end points toward the ground on coming to rest, the shell passes muster.

How far off balance may the shell be? In a 120-millimeter French shell—a projectile slightly less than $4\frac{3}{4}$ inches in diameter and weighing, unloaded, close to 40 pounds—about the distance between two pin scratches placed as close together as possible without touching.

The balance of the shell lengthwise is more easily found. All that is necessary is to balance the shell on knife edges, much as one would balance a pencil on one's finger. The point of balance must be at a definite distance from the base of the shell. A variation of more than one per cent. in the length is sufficient to disqualify the shell.

Train Your Skin So That It Will Not Be Sensitive to Cold

It is pretty generally believed that exposure to cold and wet weather will bring on the disorder known as a "cold." But sensitiveness to cold is usually due to the fact that the nerve centers controlling the circulation of blood through the skin are over-delicate, and exhibit a sort of hair-trigger reaction to exposure. By accustoming the body gradually to cool and later to cold baths, resistance to cold is set up.

A French "75" Anti-Airplane Gun with a Camouflage Dressing

THE French have found still another use for the versatile "75." They have mounted it on a motor-truck chassis, heavily armored, and have sent it close to the front to pepper German airplanes. The accompanying illustration shows the new combination of motor-truck and big gun and the crew of three that operate each unit.

The truck is painted and covered with boughs to hide it from the eagle eye of the enemy air scout.

Look closely at the photograph and you will see that the truck is provided with stabilizers in the form of iron legs or "jacks" which actually anchor the truck body to the ground.

These stabilizers are located one behind each rear wheel, one on each side of the truck in front of the rear wheels, and one behind each front wheel.

When the truck is moving, the stabilizers are carried in an inoperative position, but as soon as the truck stops and the command to attack an enemy squadron of airplanes is given, the six stabilizers are forced into the ground, giving the big gun a firm foundation to fire from.

Sixty Miles an Hour Is the Climbing Speed of Flying-Machines

A MODERN airplane weighing as much as a small touring car without any passengers can climb at the rate of sixty miles an hour. The aviator would say that his machine's rate of ascension is 1,300 feet a minute. Such an airplane would have an engine of a brake horsepower of 180. The airplane climbing at sixty miles an hour ascends a gradient of 1 in $3\frac{1}{2}$ to 1 in 4.



French Official Photo

What the French have in store for German airmen—the famous French "75" mounted on a motor-truck chassis

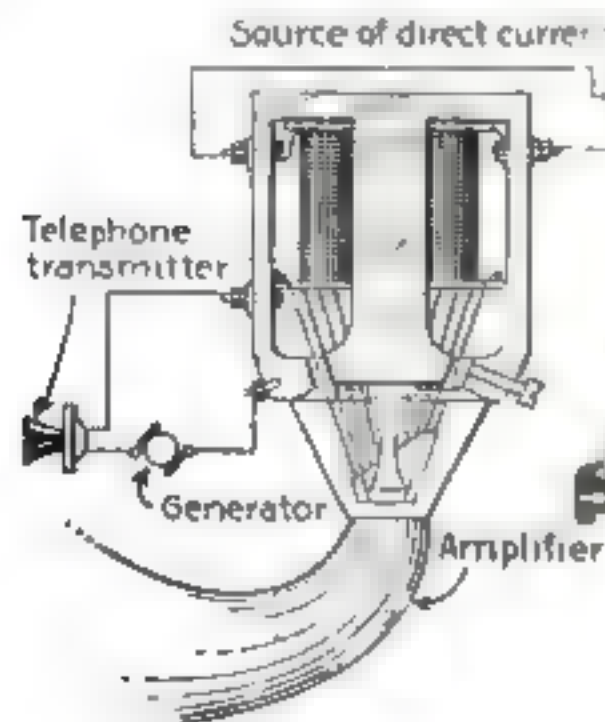
Making Telephones and Phonographs Speak Perfectly

A TELEPHONE receiver for reproducing the sounds of the talking voice without any of the hissing, spitting and scratching that now accompany telephone conversation, is an invention of Erik Christian Bayer, of Denmark.

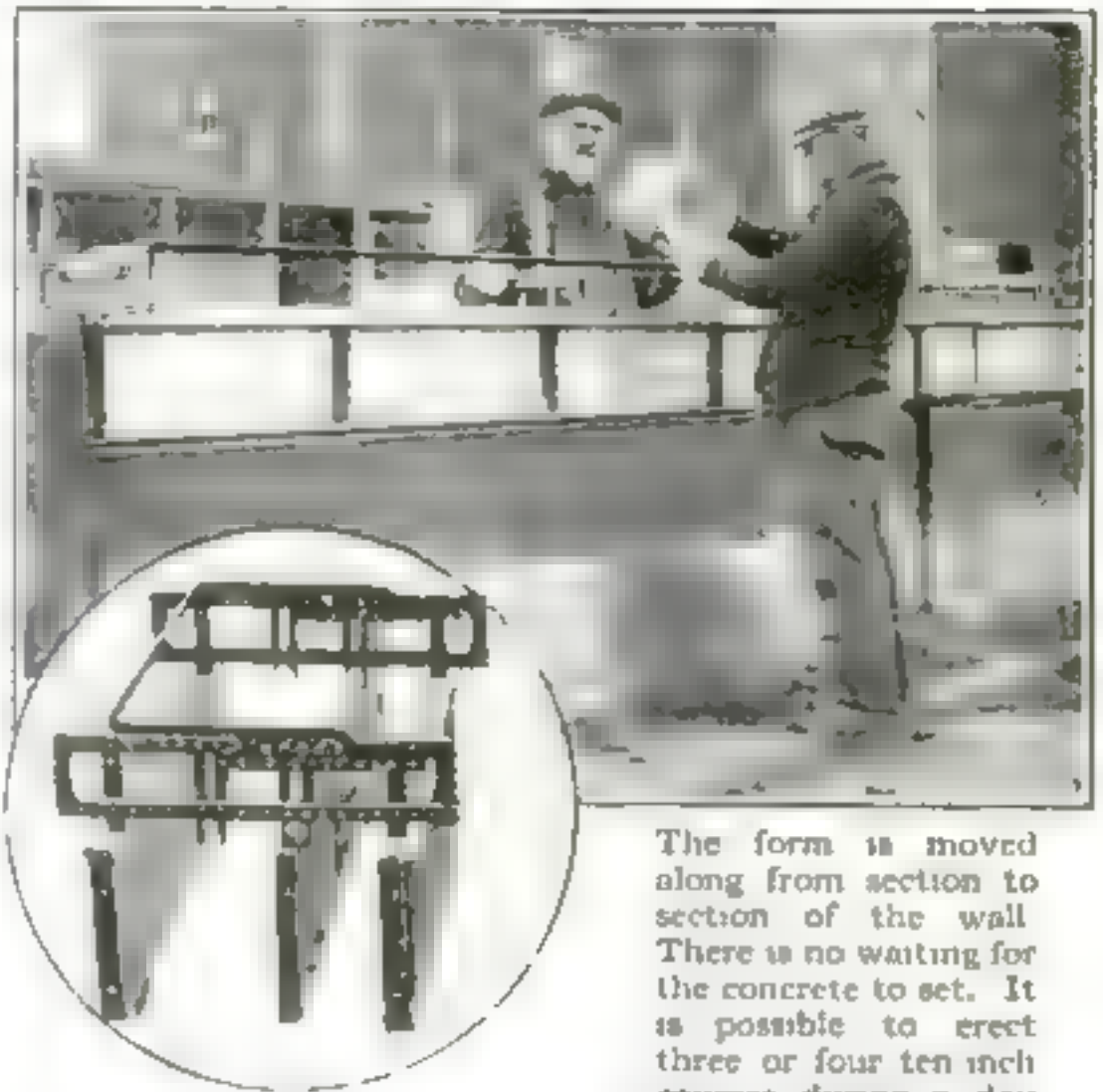
This receiver works on an entirely new principle. Instead of a single sound-producing diaphragm, his device uses a number of wires. These wires vary in length much like those of a piano, and each wire produces its own fundamental tone. And like the wires of a piano, they vibrate with different strengths and thus produce other complex sounds. In this way, the reproduction of voices is obtained. By eliminating those wires which would produce the singing and other noises in the telephone line, these foreign sounds are entirely excluded from the transmission.

By connecting the ordinary phonograph, through a telephone transmitter, with this novel receiver, Bayer hopes to strain out all impure secondary sounds—even the scratching of the needle itself.

This application of the idea although simple, does not seem practical, however; for it is only reasonable to infer that the impure sounds that might possibly be introduced by the transmitter would be almost if not equally as annoying as those weeded out. The photographs below show the diagram and application of the device.



The electric current going through the wires, vibrates them and produces the voice sounds. All wires that would set up other sound vibrations are inactive



The form is moved along from section to section of the wall. There is no waiting for the concrete to set. It is possible to erect three or four ten inch courses during a day

Any Boy Can Build a Concrete Wall with This New Metal Form

A WISCONSIN man has invented a new type of metal concrete form for constructing hollow or solid concrete walls. The supporting frames of the form are rigid while the arms supporting the mold boards are of flexible spring steel which prevent the form from bending out of shape. The rigidity of the form makes it possible to erect walls true and straight.

Fresh concrete is spread into the mold and tamped down until the mold is completely filled. Then a lever is raised which releases the machine from the wall. The form is moved along and another section of the wall is formed. There is no waiting for the concrete to set. It is possible to erect three or four ten-inch courses in a day.

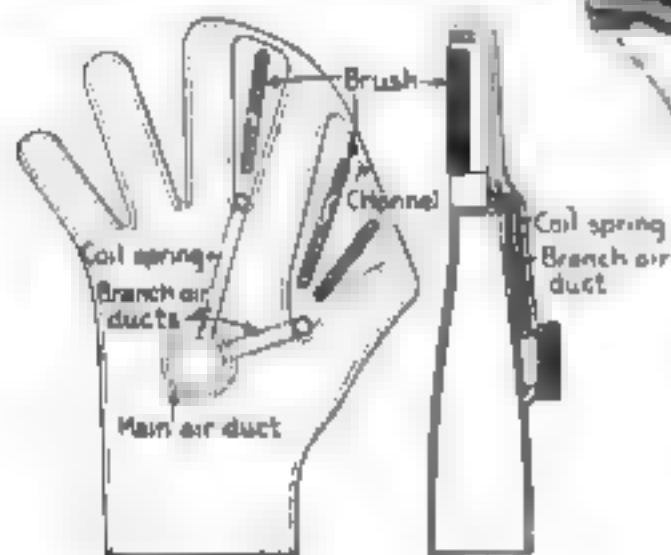
The expense and waste of lumber in building forms is done away with. By the aid of this form any novice can erect cement walls for buildings or partitions.



Grooming the Horse with a Vacuum-Cleaner Mitten

THE latest application of the vacuum-cleaning principle is to the grooming of horses. Walter B. Guild, of Roxbury, Mass., has invented a kind of glove which takes the place of the old curry comb and brush and cleans the hide thoroughly and quickly.

Between the fingers of the glove small, stiff brushes are set. These stir up the dust in the hide. The brushes are separated from the walls of the



The vacuum-cleaner mitten which takes the place of the curry comb for grooming horses. It is a time-saver

The brushes between the fingers stir up the dust which is sucked up through the hose at the back of the glove

channels into which they are set, so that there is a free-air space around them. Into this free-air space the dust is sucked up, to be drawn into a main air-duct attached to the back of the glove. This main air-duct is connected with a suction hose and pump. The brushes are simply sets of bristles wrapped about a flexible rubber core so as to bend with the fingers and conform with any irregularities of surface.

Such a cleaning mitten is believed to be a means of preserving the health of the grooms, since the dust which is invariably imbedded in the hide is not allowed to escape into the air of the close stall to be breathed into the lungs of the workmen. With such a mitten it is claimed that one man can do the work of three without loss of time.

Why a Sidewalk Was Built on the Top of a Storm-Sewer Tunnel

BECAUSE a Pasadena storm-sewer could not be built low enough to avoid conflict with the sidewalk above it and still retain a down grade to insure a flow, the sidewalk was placed on the top of the tunnel.

The top of the sewer projected above the point where the foundations of the sidewalk would naturally begin. Hence the contractors decided that the easiest remedy for the situation was to build the sidewalk on the top of the tunnel and as an integral portion of it.

Now hundreds of persons daily walk over the sidewalk without the slightest knowledge that they are traversing the top of a sewer. Only if you chanced to be unusually observing and reached the end of the

walk, would you be likely to discover the details of the construction. At the end there is a concrete abutment to prevent you from absent-mindedly walking off into the open portion of the big drain.



The top of the sewer projected above the point where the sidewalk began, so the sidewalk was built directly over it

How Old Is the Earth? As Old as the Salt of the Sea

THE salt of the ocean has been made to give an answer to the question of the age of the earth. The general idea seems simple enough to be worked out by anyone with a plentiful supply of good long pencils and sufficient paper.

Salt is carried down year after year into the sea, where it accumulates. If, then, we can divide the entire amount of salt at present in the ocean by the amount carried down in a year, the quotient will be the probable age of the earth. Simple? Oh yes. Professor Joly has worked it out to ninety-nine million years, but to be on the safe side he reduces that number to ninety million. A little matter of nine million years is negligible to those who can think in such numbers.



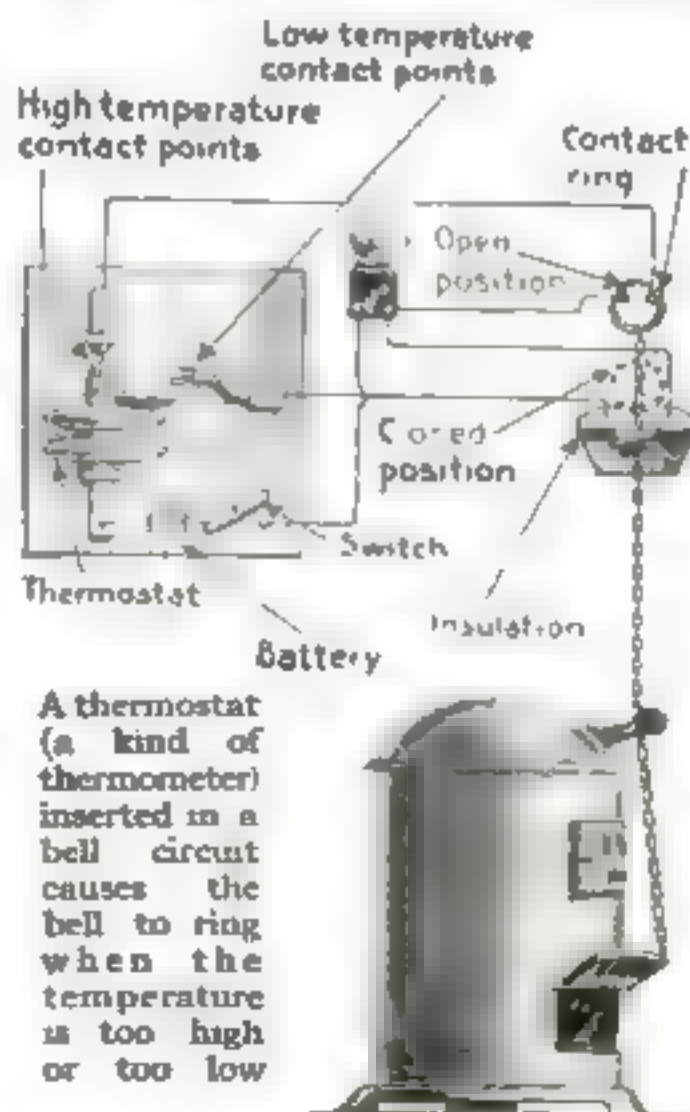
The steam shovel moved along by its own power on its self-laid track at the rate of about four blocks a day through the wide streets of the city

The Temperature Alarm. It Tells You Whether You Are Too Warm or Too Cold

THE burglar alarm now has a rival in the temperature alarm. A bell rings to inform you that you are too warm, or too cold, as the case may be.

Let us assume that the damper on your furnace is open, which, of course, causes the fire to burn fiercely. A chain is attached to the damper at one end, and at the other to a metallic ring. The ring is part of an electric circuit in which the bell is located. A thermostat (a kind of thermometer) is inserted in the circuit near the contact point, and swells when the house becomes too hot. This causes the contact points of the thermostat to touch, and the circuit is thus closed, so that the bell rings.

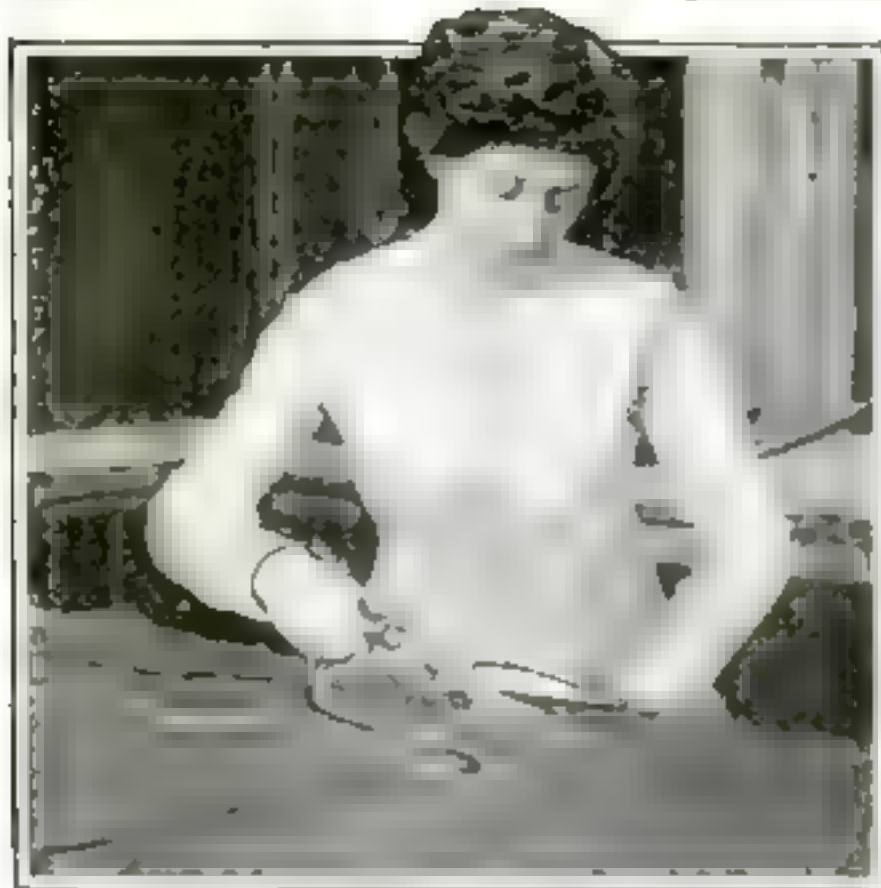
Upon hearing the bell ring, you realize that you are too warm. You move the metallic ring down to another position which breaks the circuit, causes the bell to stop ringing, closes the damper and cools the house.



How a Railroad Steam-Shovel Traveled Through New York City

IN excavating the site for a new hospital in New York city a contractor made use of a gigantic steam-shovel mounted on a standard railroad flat-car. Upon the completion of the work the shovel had to be transported to the next scene of operations, in this case several miles away, the route being entirely through city streets.

No alternative presented itself to the mind of the contractor to a plan to lay tracks for this self-propelled steam-shovel and to pick them up again after the shovel had passed on. So, making use of three short sections of track consisting of standard rails held the required distance apart by iron rods, the steam-shovel started on its queer journey. As it passed, under its own power, from the last section to the second section, a team of horses hauled the last section around to the front of the shovel to form a new length of track.



The flexible shaft from the motor rotates the cam. The bearings of the scissors shanks, on running in the cam groove, operate the blades of the scissors

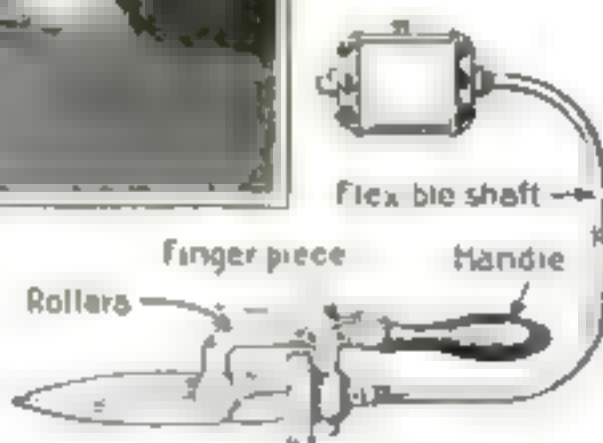
Click! Click! Go These Electrically Operated Scissors

IN large factories where clothing and uniforms are made by the thousands, the cutting of the miles of cloth required is a tremendous job.

Much of the tediousness of this work has been eliminated by the power-operated scissors invented by John Schultz, of Chicago.

A rotating groove-cam works the shanks of the scissors back and forth just as the cutter's hand would ply them. The cam, however, rotates so fast that the shank-bearings, traveling in the turning 8-shaped groove, are moved many times faster than a man could operate them. Moreover, the strokes are more powerful, since the electric motor which turns the cam by means of the flexible shaft connected with it is several times as strong as a man's hand.

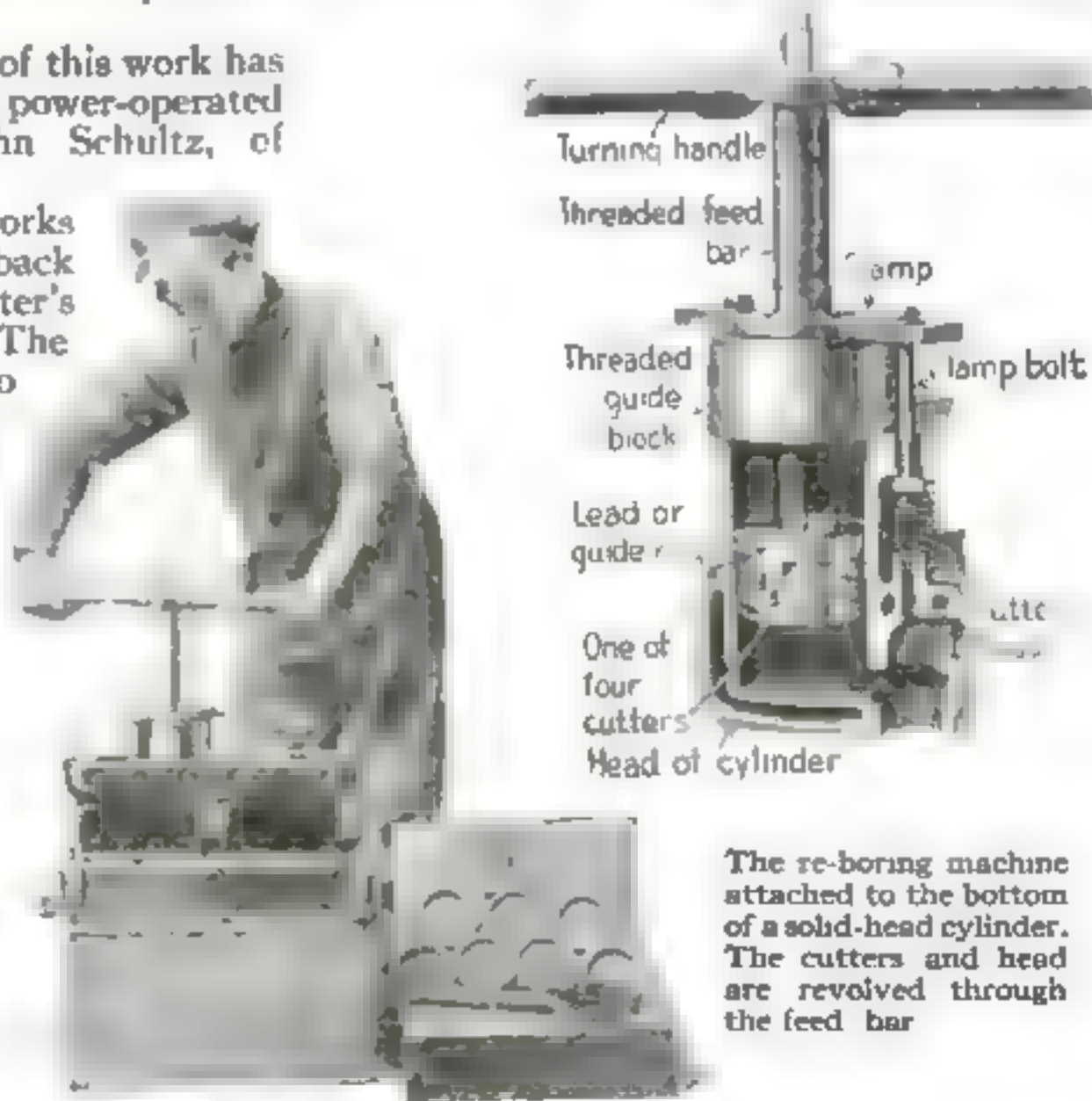
The scissors therefore can cut several thicknesses of cloth where a man would cut but one.



A Simple Cylinder Re-Boring Machine for the Car-Owner

THE mechanically inclined automobile owner can rebores his engine cylinders in from one-third to one-tenth the usual time and without the services of an expert mechanic, if he uses a simple machine recently brought out in Iowa. Although hand-operated ordinarily, the device can be power driven when much work is to be done in a garage. It will rebores cylinders from $2\frac{3}{4}$ to $5\frac{1}{16}$ inches in diameter on engines of either the demountable or solid-head types. In the former, the device is bolted to the cylinder after the head is removed, and in the latter to the base of the cylinders when the cylinder block is turned upside down.

The re-boring machine consists of a top guide block, with a clamp and bolts to attach it to the cylinder, and a threaded feed-bar carrying at its lower end a circular cutter head slotted for four cutters. The head is threaded inside for the adjustment of the cutters and is tapered on the outside at the bottom to keep the cutting tools straight.



The re-boring machine attached to the bottom of a solid-head cylinder. The cutters and head are revolved through the feed bar

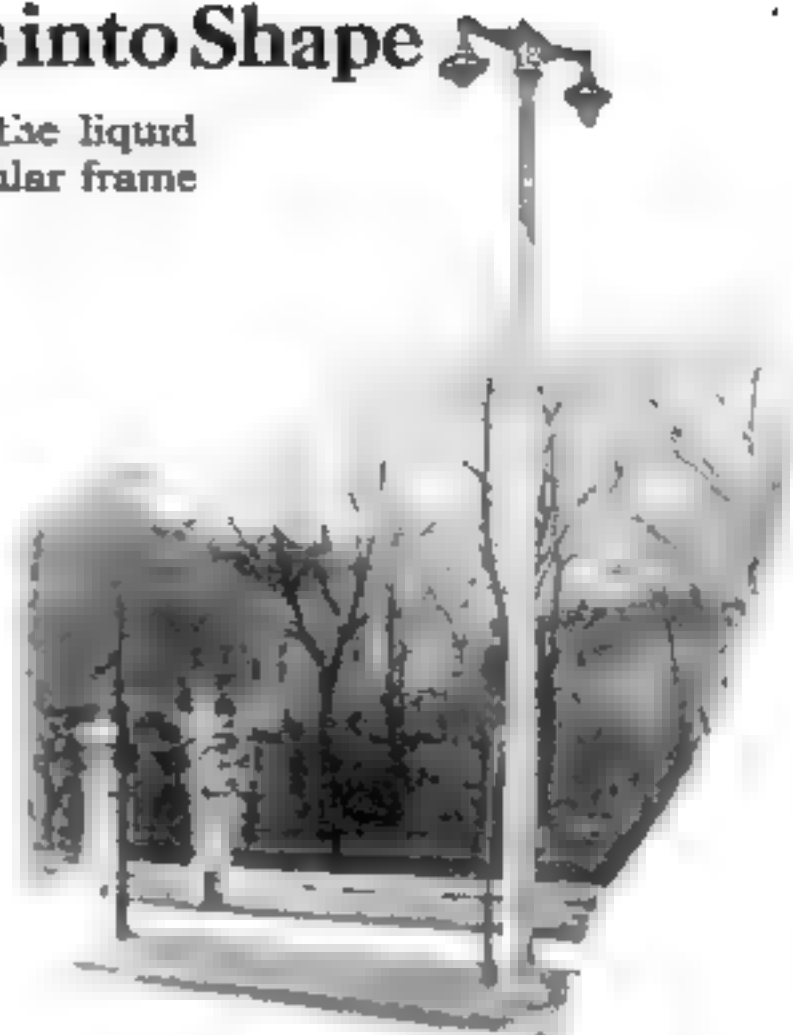
Whirling Concrete Poles into Shape

Centrifugal action is set up and the liquid concrete is thrown against the tubular frame

THE principle of centrifugal action utilized in a machine invented by Walter H. Lienesch, of Chicago, makes possible the production of substantial, attractive and inexpensive lamp poles, telegraph poles and sign posts from reinforced concrete.

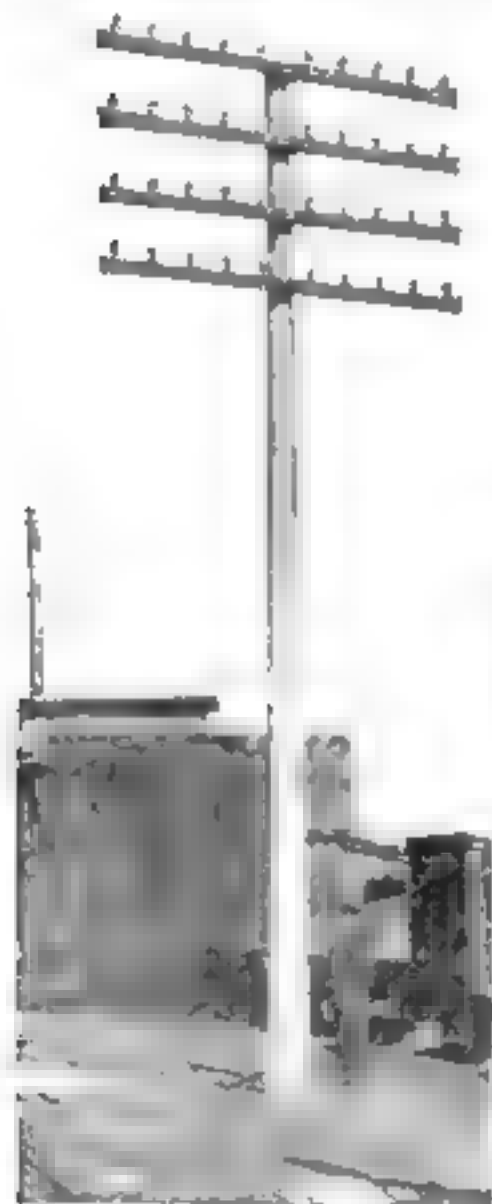
The machine consists of an outer cylindrical frame which carries the mold and which is constructed of sheet metal, formed from two half-cylinders hinged together. Within this carrier-frame is a smaller mold-cylinder, of tapering, rather than of true cylindrical form. This mold is likewise constructed from two half-cylinders of sheet metal, hinged together. The inner mold is supported by braces carried within the outer carrier-frame or cylinder.

Both frames are opened and concrete is poured into the inner mold cylinder to partly fill it, reinforcing wire netting having been placed in the mold first. The mold and the outer carrier-cylinder are then bolted or latched together.

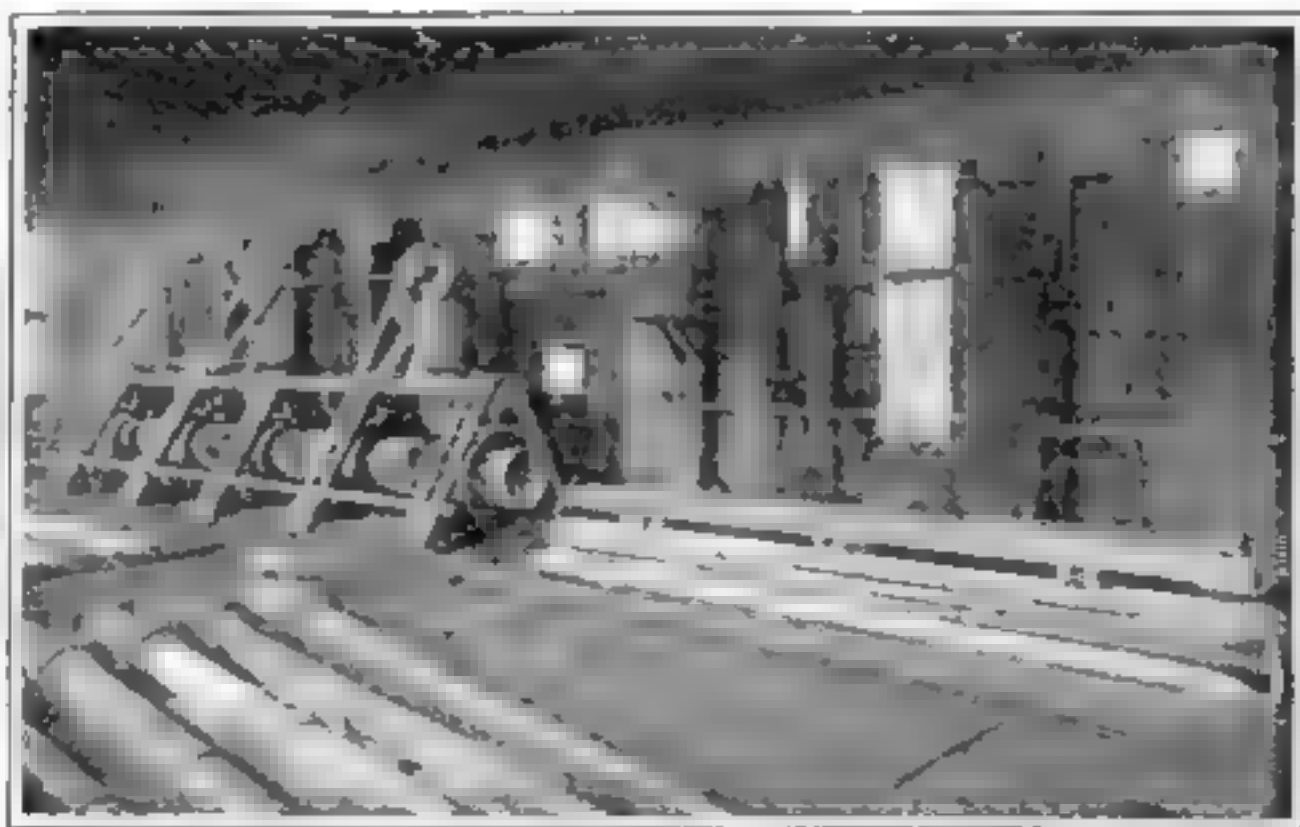


The concrete lamp posts are unusually attractive and are made in different styles

A motor which is connected with the carrier-frame by a flexible shaft is started up, and carrier-frame and mold are rapidly rotated axially. The resulting centrifugal action whirls the concrete compactly against the cylindrical mold sides to form a tubular pole. The operation is continued long enough to allow the concrete to harden. The machine is then stopped and the newly formed concrete pole is removed. Poles of almost every type can be thus formed.



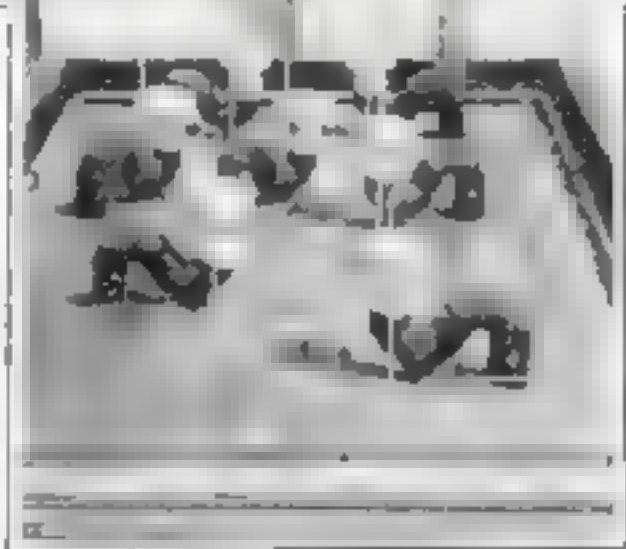
A telegraph pole of concrete recently erected in Milwaukee. It will probably be doing as good service as now one hundred years from today



The mold is constructed of comparatively thin metal and is light in weight so that it can be readily removed from the carrier-frame after the pole has been completed and is ready to set up



Alice is pointing to the waxen seal which melts as soon as the heat becomes intense. The melting of the wax releases the fire doors, starts the sprinkler system and calls the fire department. At right, the roof of the film storage room. The huge ventilators furnish an exit for the combustible celluloid fumes.



a tiny wax seal which controls the mechanism of each door. The moment the wax is melted the springs release the latches that hold the open doors, and the doors, being mounted on a sloping pulley, close by gravity and latch automatically. The closing of any one of the doors makes an electrical contact which turns in a fire alarm.

The sprinkler system is so arranged that the entire outside walls of the building are drenched the moment the water is turned on. Showers also send their contents down the ventilators on the roof. A similar sprinkler system sprays the interior of the building, the water being directed so that it falls on the walls and woodwork but not on the films.

Fire Doors That Close Themselves When the Temperature Rises

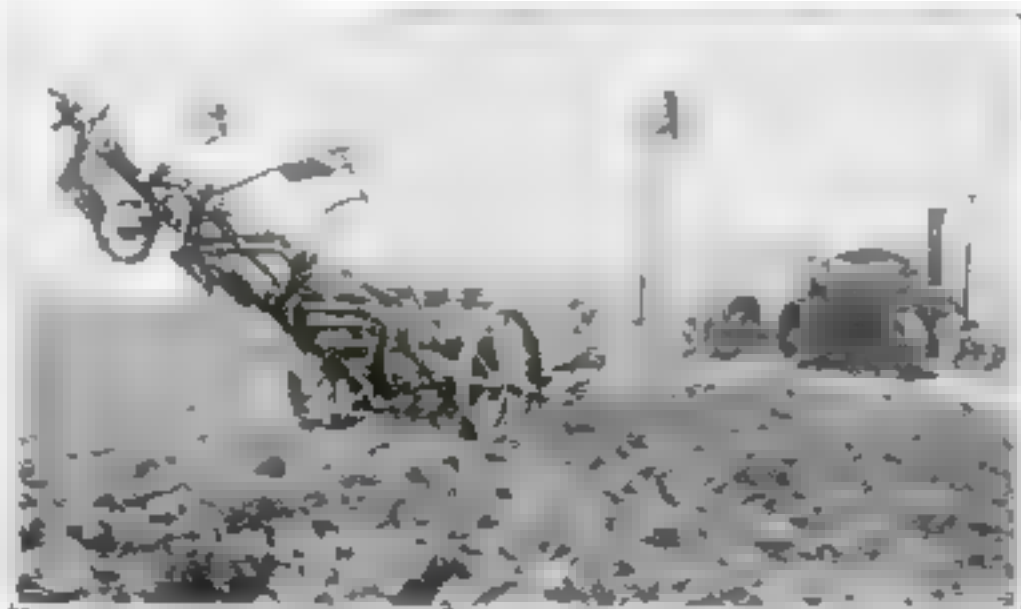
IN a certain film storage vault in Culver City, California, highly inflammable motion-picture films worth at times five million dollars are stored. Naturally, the vault is provided with every known protection against fire.

The walls of the building are of special fire brick, plastered on the outside for the sake of appearance. A four-inch layer of asbestos lines the interior, and this in turn is covered with a layer of one quarter-inch boiler plate. The most interesting features of the protective plan are four steel doors which close automatically when an excessive heat is reached.

Suppose that a fire breaks out. The heat melts

This Is the Way They Plow in Porto Rico

THE prize for queer ways of plowing a field goes to Porto Rico. In this land of the sugar cane it takes two engines to run a plow, yet the engines do not travel over the plowed ground. The engine seen at the right in the photograph below remains idle, while a similar engine to the left, but not visible in the photograph, is pulling the plowing machine in its direction by means of a steel cable which is shown attached to the lower part of the machine.

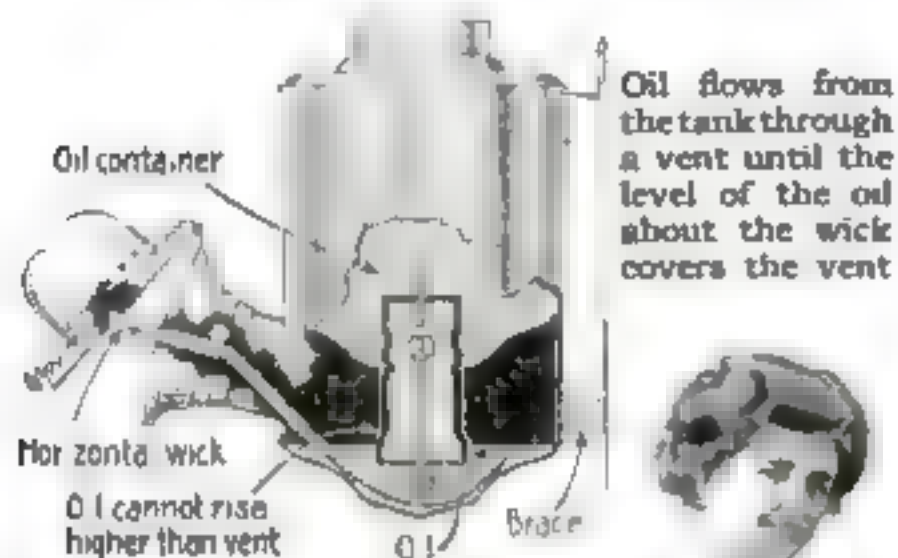


How they plow in Porto Rico. The plowing machine is drawn back and forth across the field by two traction engines, one on each side of the furrows.

There are eight plows to the machine, four on an end. When the machine has been pulled all the way across the field the end which now appears in the air will be lowered to plow the next furrow in the opposite direction.

This Kerosene Lamp Has a Horizontal Wick

TO the thousands of people still obliged to rely upon kerosene as their means of illumination, this new angle-lamp will be decidedly welcome. The outstanding fea-



ture is the position of the wick and burner, which, instead of being vertical, is almost horizontal. This shape not only permits a separation of the burner and the tank for oil, but also gives a much better distribution of the light.

The old style oil lamp cuts off entirely the rays directed vertically downward, which are the very best for illuminating purposes. In the angle-lamp the flame is at one side of the support, instead of above, so that the downward rays are not interrupted. Whether a wall lamp or a hanging lamp is used, a good light thus falls on the work or paper underneath.

The oil travels to the flame through the wick easily. The supply at the base of the wick is kept constant by a device much like that in the student lamp. Oil flows from the tank through a vent until the level of the oil about the wick covers the vent; then no more can escape until the supply about the wick has been nearly used up and the level falls below the vent.

As the tank is at some distance from the burner, and not underneath it, it can be lifted out for refilling without dismantling the lamp, or even extinguishing the flame. This assures safety, and also means much less work for the caretaker. The lamp is lighted by swinging the globe-holder on its hinge; this eliminates removing the globe. The air enters through the burner at right angles to the direction of escape through the globe. This compels it to eddy back through the flame before it escapes.

As the tank is at some distance from the burner, it can be lifted out for refilling without dismantling the lamp

A Bungalow Takes a Sail Across San Francisco Bay

A CALIFORNIA millionaire purchased a plot of ground on the opposite side of the bay from his residence. A moving contractor took the contract to move the house across the bay, and the bungalow is shown below on the scow, ready for the trip. A small tug-boat hauled it.

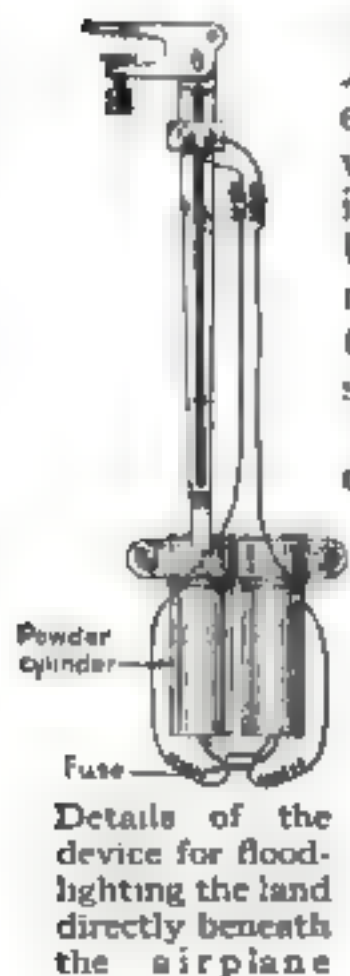


The bungalow taking its trip across the bay in preference to a long detour by land. It was loaded on a scow and hauled by a tug-boat, reaching its destination in a few hours



A touch of an electric button ignites the powder. It flares up and lights up the surrounding country

Making a Safe Landing at Night From an Airplane



AN aviator so unfortunate as to have his engine go back on him while flying along at night is in a precarious position. Until recently, there was nothing for him to do but to trust to luck and descend.

By the invention of Harold E. S. Holt, of England, however, the extreme danger of such a position is mitigated. The principal feature of his device is a long steel arm which hangs down from the airplane. This is a flood lighting arrangement. You press an electric button, the powder held at the end of the steel

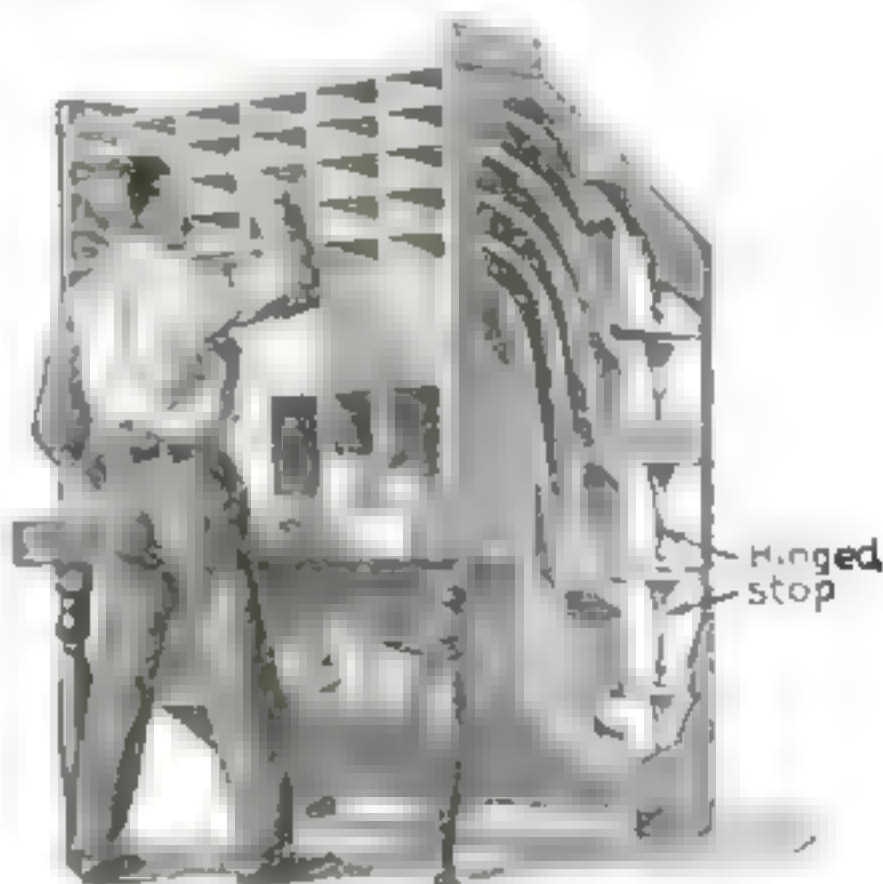
arm is thus ignited. This powder is the sort of stuff which mariners use in signaling in stormy weather; a powder which burns long and with an intense flame. Thus the landscape below the airplane is lighted up so that you can see plainly to choose a landing place which promises a fair degree of safety.

Sorting Letters with Gravity Chutes in the Post Office

IN a large city post office where millions of letters a day are received, the problem of sorting them usually requires a staff of men nearly as large as that necessary to deliver the letters about the city. To reduce the expense of sorting, William G. Axworthy, of Montclair, New Jersey, has designed a sorting case by which the letters can be sorted in about one-half the time usually required. The case consists of five horizontal rows of very narrow compartments, all close together. The pile of letters to be sorted is placed in a horizontal position at the level of the middle row of slots. The practiced eye of the sorter can recognize the town where the top letters are to go just as quickly as

the letters can be uncovered. Due to the close proximity of the slots, the letters can be thrown into the respective compartments assigned to them at the same high speed.

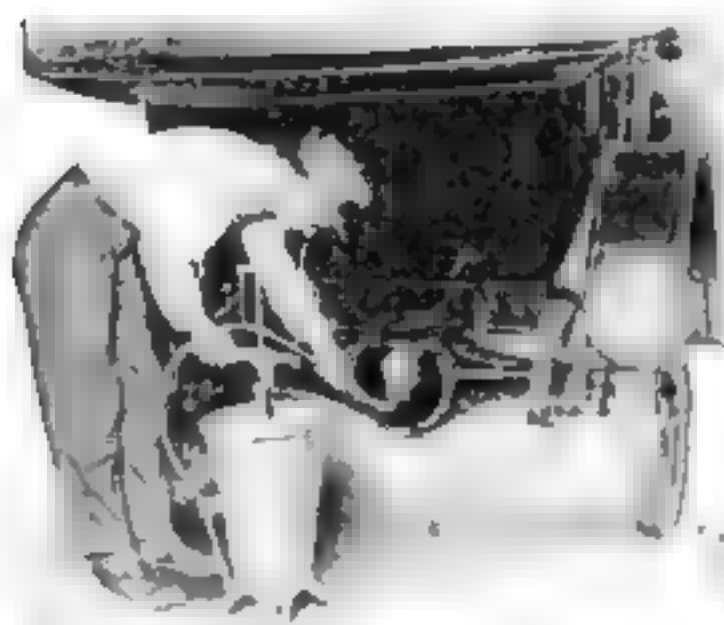
How different is the old system where the slots are deep and must be built over five vertical feet of wall space! No longer is motion lost in reaching down to the slots near the floor. This operation is effected by little chutes in back of each slot. The letters fall down these chutes into the larger storage compartments below.



The letters for the lower compartments are dropped into slots and carried down by gravity

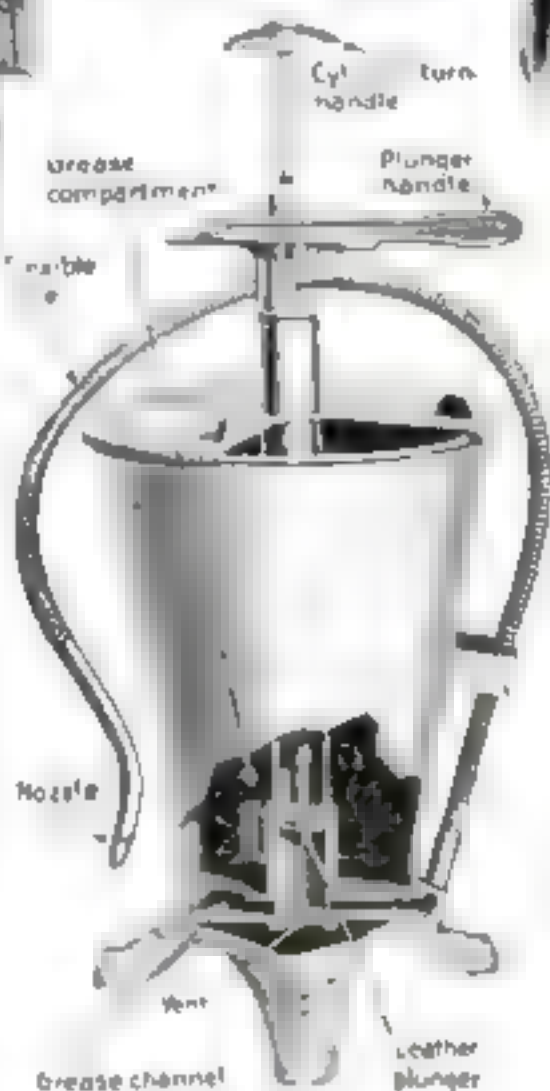
A Valveless Pump for Gearset Grease

It sucks out the old grease, pumps it into another receptacle and feeds in fresh lubricant



Filling a transmission gearset with new grease which is carried in the valveless pump

Below: Details of the valveless pump. The horizontal flange at the bottom of the cylinder forms practically a double bottom



Sucking old grease out of a rear axle housing. Not a drop is spilled on the woodwork

FILLING the transmission gearbox or removing the grease from it or from the rear axle of an automobile is generally an operation which requires a man to put on overalls and gloves if he is to be at all presentable when he finishes the job.

This drudgery can now be done away with by using the simple valveless bucket shown in the accompanying illustrations. This can be used to fill the gearset or axle with grease or oil carried in the bucket itself; to feed in a different lubricant instead of that in the bucket, or to suck old grease out of either part and pump it into some other receptacle for use elsewhere.

The device consists of a heavy sheet-iron receptacle in the shape of an ordinary bucket and fitted with a central brass tube inserted in a cast cylinder at the bottom of the bucket. This cylinder has a horizontal flange at the bottom which forms practically a double bottom, the space between the real and false bottom opening to the lower end of a flexible metal hose.

The brass tube may be turned one-quarter turn either way to bring a rectangular hole near its bottom into register with the passage to the hose or with the

bottom of the bucket through holes in the horizontal casting flange. In the latter case a charge of the grease in the bucket is sucked into the brass tube by the upward stroke of a small piston inside of the tube, operated through a small finger grip on the outer and upper end of the piston rod.

The brass tube is then turned one-quarter way around and the piston forced down by an easy downward pumping stroke of the lever handle with one hand, leaving the other free to guide the free end of the hose, the grease meantime being forced out as the piston descends.

Similarly, closing the bottom of the bucket and opening the passage to the hose by turning the tube another quarter revolution sets the device so that an upward stroke of the piston will suck old grease out of the gearset or rear axle. The next downward stroke will force it into another receptacle.

There is no dirt or muss, and the old greasy overalls may be discarded without any regrets from the list of indispensables around the automobile.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Powder Gases Wash Away Steel Guns

The process is the same as that by which a river cuts away its banks

By Edward C. Crossman .

WHEN a modern infantry-rifle cartridge is fired in a rifle-barrel, the heat generated by the powder gases is measured by some 4000 degrees Fahrenheit. One shot does not matter much, two shots in rapid succession raise the temperature of this steel a bit more, three shots are still worse, but twenty, fired at machine-gun speed, raise an ordinary barrel to a steak-broiling temperature.

The gases pushing behind the bullet and traveling at high speed with the pressure of 50,000 pounds to the square inch, literally wash away the softened steel just ahead of the chamber as fast as it is heated by the high temperature of discharge. The process is known as erosion—a washing away. When a river sets in to cut away its banks, it also erodes.

Because machine-guns are fired at high speed and are used for a comparatively long series of shots without a pause, their chief foe is this erosion. If machine-guns were fired as the average layman supposes—one continuous blast of bullets while the argument lasts, they would be out of commission in a couple of thousand shots, which means an actual firing life measured by a few minutes. No cooling system ever invented

will keep down the temperature on the inside of the barrel with such usage.

Because of this, because of the necessity for re-laying the gun on the mark every

twenty shots or so, and because of the slight delay in inserting a new belt or drum or clip of ammunition, the guns are fired in short bursts, each followed by a pause. The Germans use two guns at detached points, alternating their fire to avoid over-heating and to avoid the delays incurred by inserting new clips or belts.

Even used in this way, machine guns show erosion very quickly. The

photograph shows the barrels of types of American machine guns, fired 2,000 and 3,000 shots. As the photographs plainly show, ahead of the chamber, which is the portion where the cartridge rests when the gun is loaded, the barrels are washed away on either side until the bore is larger than the neck of the chamber.

The result is that the hot gases rush past the bullet which does not seal the gap, and wash still more steel away, and so on, around the vicious circle of damage. The barrels shown in the photographs are sectioned lengthwise, showing only one half of the bore of the guns.



These are American machine guns which have been fired from 2,000 to 3,000 times. Ahead of the chamber, which is the portion where the cartridge rests when the gun is loaded, the barrels are washed away on either side until the bore is larger than the neck of the chamber. The result is that the hot gases rush past the bullet, which does not seal the gap, and wash still more steel away, and so on, around the circle

An Iron "Flag" for Protecting the Railroad Car Inspector Against Injury

LAST year a single railroad killed four men and injured nearly four hundred others who were underneath the cars inspecting and making repairs. The blue flag which they had stuck in the ground a short way off to warn locomotive engineers of their dangerous position had fallen down or had perhaps been knocked down by some careless workman.

In an effort to put an end to such needless and pitiful slaughter, a railroad equipment company has developed a fool-proof flagging device. A blue "flag" of iron is placed on the track in front of the car to be repaired. The repair inspector locks this to the track and only he can remove it. Little chance now for an engineer to plead ignorance and to back his train into the other car.

This iron flag can be planted on the track, winter or summer, in a few seconds. The flag standard is an iron pipe inside which two clamp arms slide. When the arms drop down, they can be placed over the sides of one of the car rails. The inspector then shoves the pipe down. The arms come together and hug the rail securely. The inspector then padlocks them to the rail



Padlocking the blue metal flag to the track to warn engineers against backing their trains into the car that is being repaired

When the flag standard is shoved down, the arms clamp the rail. When it is locked, only the inspector himself can remove it



The tree stood in the pathway. Rather than chop it down a path was cut through it

"Woodman, Spare That Tree," Said the People to the Roadmaker

WEST of the Rocky Mountains, trees of enormous size are numerous. Many of them are supposed to be hundreds of years old and are consequently revered. To cut down a tree which has taken so many years to reach development seems a crime. Therefore when the Westerners find one of them blocking the path of progress they resort to various expedients to give it the right of way without sacrificing the public needs.

The accompanying photograph shows a tree which completely blocked the foot-path of a new street in Everett, Washington. The tree was a fir and was in full foliage. Rather than cut it down or compel people to make a detour around it, a pathway was cut directly through it, wide enough for two people to pass abreast. It was finished off at the top in an arch, which enhanced the ornamental effect. The cutting did not harm the tree. In some of the redwood trees of California paths have been cut wide enough for horses and wagons to pass through.

Telegraphing by Typewriter

How one telegraph company doubled its facilities without adding a single wire

TO provide adequately for the handling of its enormously increased business, the Western Union Telegraph Company was recently confronted with the problem of doubling its service facilities. To double the number of telegraph lines, and therefore, to increase the number of employees, was too costly for serious consideration. Automatic telegraph operators were installed. Their speed is so great that more than twice the number of telegrams formerly handled can now be sent over the same lines.

This is how it was made possible. Typists take the place of key operators. As they operate special typewriters, they perforate a narrow strip of paper with a number of holes, the arrangement of which varies with each letter of the alphabet. A strip of paper is to the new system of telegraphy what the music roll is to the player-piano. As a given perforation in the music roll determines the note to be played, so a tape perforation determines the letter to be printed at the receiving station. A tape is typewritten and drawn through the electric transmitter so quickly that one thousand, six hundred and fifty words can be sent in the time required by one typist to send a thousand words with the regular key.

Thus the company has increased the amount of business it handles by sixty-

five percent, without the addition of a single new line! It did not stop at that, however. Key operators can work "quadruplex"—

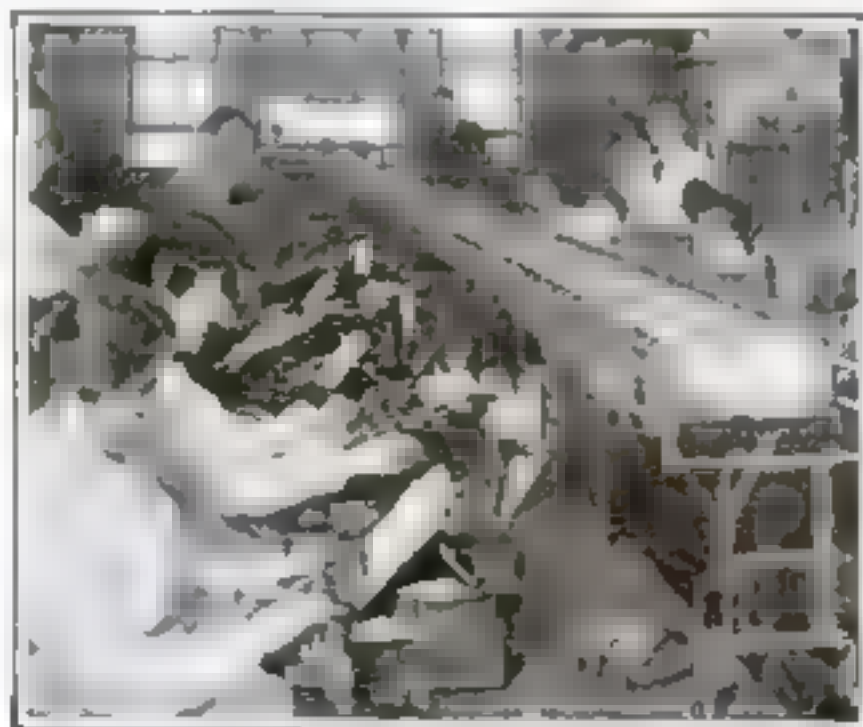
that is, four of them can send their messages over a single wire, two in one direction and two in the other direction at the same time. The typewriters were made to do the same. We thus come to the second improvement, a device which allows four messages to be transmitted from the sending

station and four in the opposite direction from the receiving to the sending station at the same time and over the same wire! Two brushes, one at each station, rotate over four segments at the same speed and come in contact with corresponding segments at all times. At one station, the four segments connect with the four tape transmitters; at the other, they connect with the four printing machines. While one transmitter is sending a letter to its corresponding printer, the brushes will be moving toward the next segment. The

printer levers will select the letter and will print it on the regular telegram blank while the brushes are rotating over the three remaining segments. The first printing set is then ready for the next letter. This happens with every segment, so that with each complete revolution of the brushes, one letter will have been sent and received by four operators.



The device by means of which four messages come and four go over the same wire at the same time



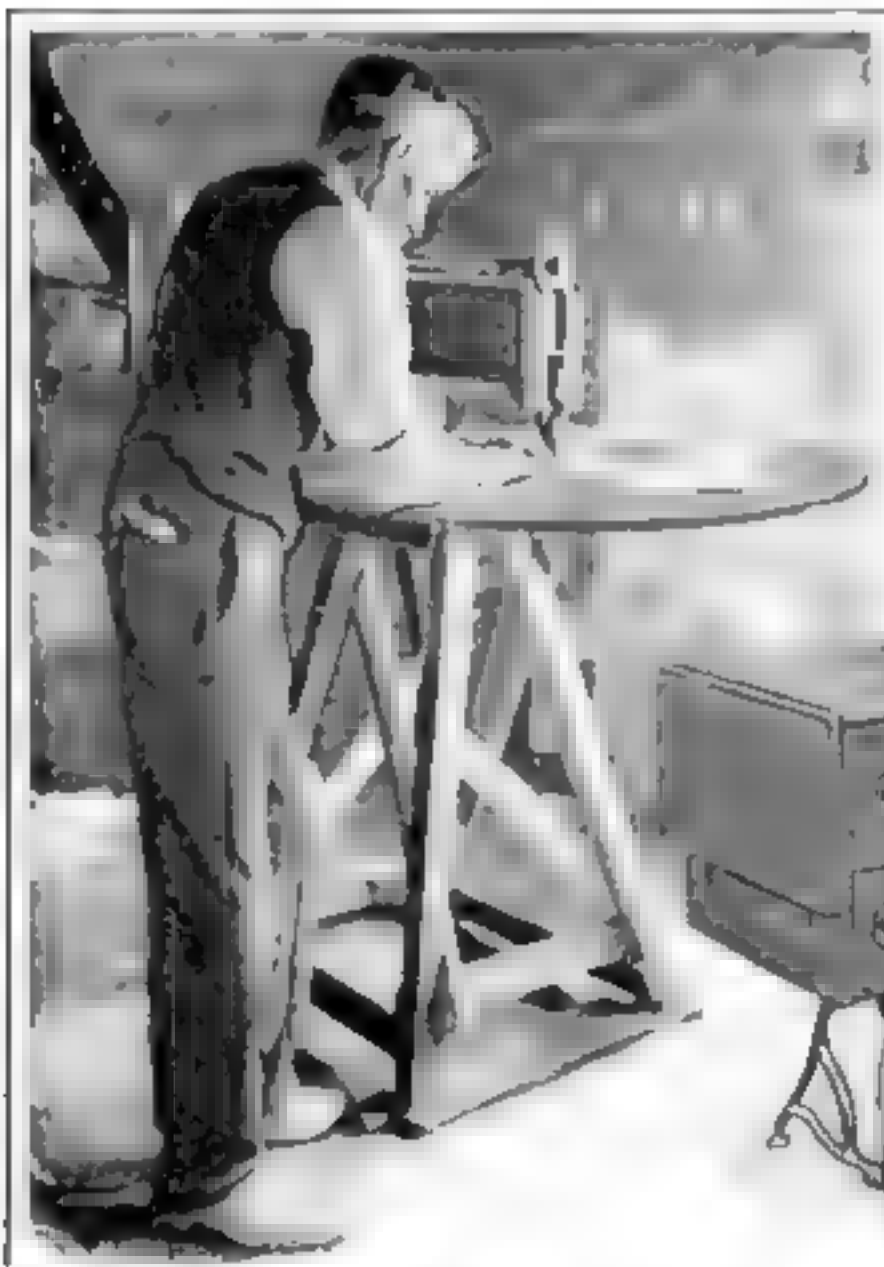
Typists operate special machines which make records of the messages in perforations on paper like player-piano records

Cutting Sheet Metal with a New Machine

HERE is a new machine which cuts sheet metal satisfactorily for pattern making purposes and which turns sharp corners. It has been invented by John L. L. Krook, of Proctor, Vermont.

The primary use of the machine is the cutting of patterns required by a marble company in Vermont. But the machine is equally useful for cutting metal stencils and other patterns and for heavier sheet metal work.

The machine has a fixed cutter and a reciprocating cutter operated like a sewing machine needle. The driving-shaft is adjusted to the desired position by means of an eccentric collar which is mounted for rotary adjustment in a ring-shaped groove of the shaft. The machine operates without making much noise. The several incandescent lamps shown are used instead of a rheostat to vary the speed.



The sheet metal-cutting machine. It is patterned after an ordinary sewing machine and is run by electricity



An endless chain fitted with pushers pulls the cotton bales across an A-shaped trestle to the high level railroad track

Handling Cotton Bales with an Overhead Trolley System

A MONORAIL system which carries cotton bales over a mile at the rate of six hundred an hour has been put into operation in Texas City, Tex. The compress is located that distance from the waterfront docks and a railway line intervenes. In order to get the cotton bales to the ships quickly, the operators of the plant erected a trestle work thirty-five feet high. By means of high and low level lines, the cotton is carried across the tracks and thence to the side of the ships.

The trolleys which carry the bales are equipped with hooks, the stems of which are fastened to two ball-bearing rollers that fit the overhead rail. An ordinary chain with two hooks is suspended in equilibrium from a hole on the under part of the trolley. An endless chain fitted with pushers every ten feet pulls the bales across the long "A-" shaped trestle. From the ground it is possible to see two hundred and fifty bales traveling along slowly.

There are two lines of trolleys, the low lines running through the compress buildings for a mile as feeders to the main line on the outside; where by means of an inclined trackway, connection is made with the "high level" track.

The Giant Crane of the Austrian Navy

It has a three-hundred-foot jib and while handling a load maintains its equilibrium by means of water let into the rear ballast tanks

AT work in the Austrian Navy Yard at Pola is the largest floating crane in the world. A giant floating crane is this, with its normal lifting capacity of two hundred and forty tons. It thinks nothing of taking guns and turrets weighing sixty tons more than that and carrying them to the ships under construction about the yard.

Nothing about the ship is nearly as important as this busy crane. The other cranes of one hundred and one hundred and fifty tons capacity—wonderful cranes a few years ago!—have been relegated to the minor jobs of the yard.

The barge crane is commanded by a captain who stands at the navigating bridge. From his point of vantage, he signals the engineer at the hoisting engine to run out the cable truck on the jib and to let down the cable to the wharf. When the load—gun, or whatever it may be—is secured upon the grappling hook, the captain has it raised to the top of the jib, one hundred and eighty-seven feet in the air. Before the load has ascended many feet, he will have signaled to the boiler room just below the deck, and the barge will be steaming away towards the ship it is to equip. There she drops anchor and “straightens to” on tightening her anchor cables by her modern steam capstans.

With her mighty three-hundred-foot jib, the crane can run her burden far over the side of the largest battleship. While this is going on, water is let into the rear ballast tanks of the barge. Finally, when the load has been deposited on the battleship, this water will be forced out again with compressed air to restore the equilibrium of the barge.

This diligent little ship keeps constantly in touch with the yard headquarters by means of the auxiliary patrol boat that is assigned to her. Instructions reach the barge captain through the wireless station on board the patrol. It is through these channels that orders come when a submarine meets with mishap during its operations on the Adriatic Sea.

If the submarine has foundered within any possible reach of the land, the barge is ordered to drop whatever work it is doing

and to follow the fast patrol boat to the scene of the disaster. Expert divers put off from the yard to meet the barge on its way to the sea. Reaching the point where the submarine has been reported to have gone down, the divers at once descend, carrying the two lifting cables with them.

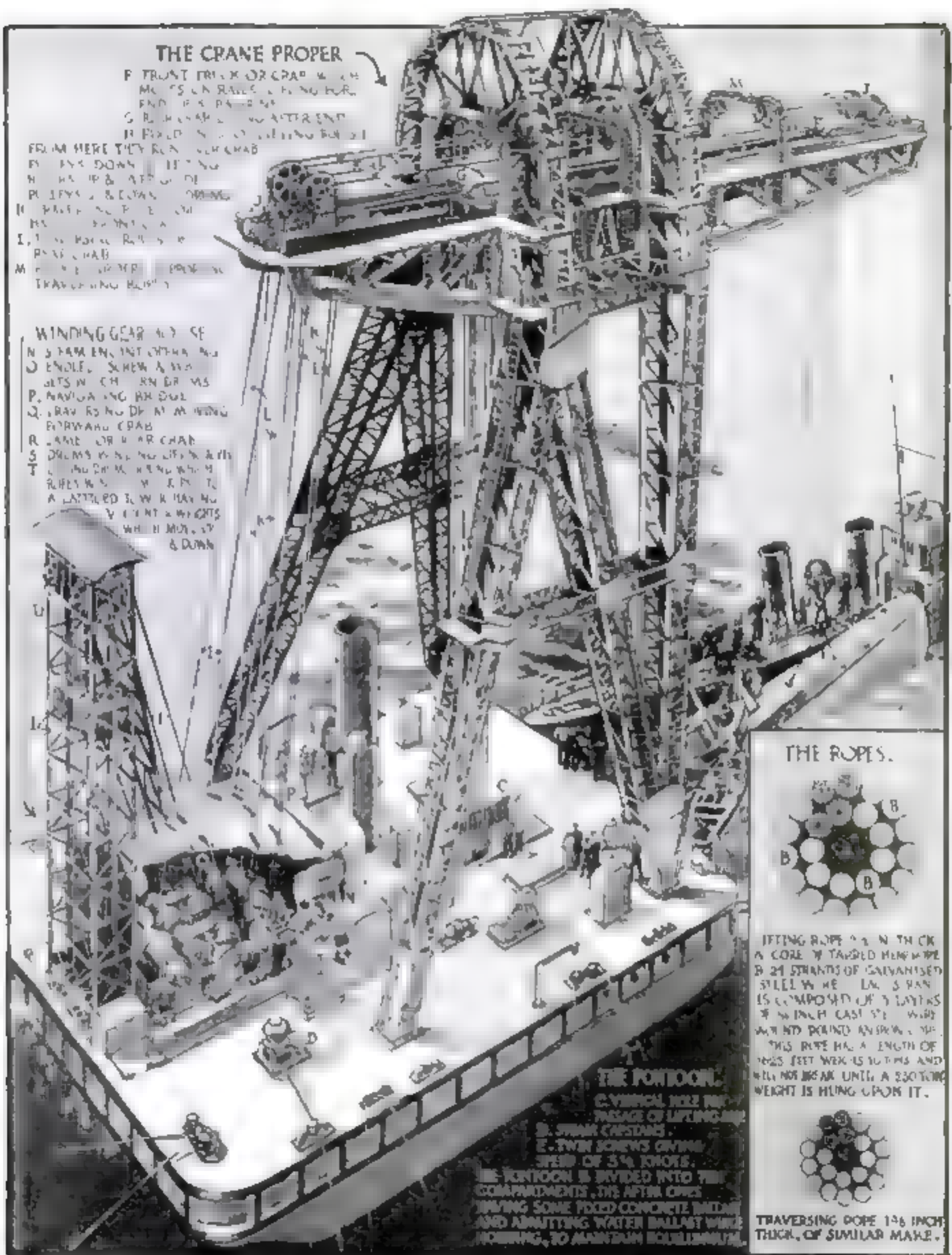
If the divers are fortunate and find the submarine, the grappling hooks are attached to the emergency eyes at each end of the U-boat's hull. Then, with the two lifting cables working together, the U-boat will be raised towards the surface at the rate of about three feet a minute. The rear cable, which goes through the hole built into the front deck of the ship, cannot lift its end of the submarine entirely out of the water. The front cable can, however, and it raises the boat until its conning-tower clears the water. In this way, the crew are enabled to escape.

American cranes are of a more specialized type, and of an extraordinary efficiency. Revolving jibs take the place of the stationary ones of the Austrian craft. Instead of having to maneuver to aline the barge in order that a load may be lowered into exact position, the American cranes maneuver the jib around.

On our floating cranes, moreover, the driving machinery is electrical. The operator is stationed in a house near the bottom of the jib. The house rotates with the jib so that the operator can overlook every motion. The electric motor controls, and even the distant-controls for the electric capstans are mounted on the switchboards in this cabin. By co-ordinating his movements, one man can handle his barge with marvelous facility.

Hence, where Austria's cranes exceed ours in size, the American cranes excel in dexterity. Furthermore, the use of water ballast to prevent a barge from tipping forward when a load is on the jib seems absurd to American engineers. Our barges are inherently stable. The crane is mounted so near to the center of the ship that twice the capacity load would not overturn it. No, we do not use water ballast—the cables might break some day and as the load falls off in front the ballast might tip the barge over at the rear!

It Lifts 240 Tons in One Load



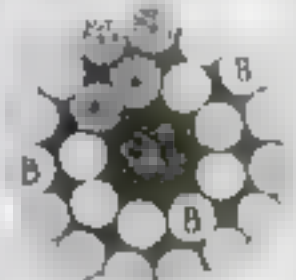
THE CRANE PROPER

F. FRONT TRUCK OF CRANE WITH
MOUNTS ON RAILS & HINGERS
END OF RAILS
G. RAILS & HINGERS
H. RAILS & HINGERS
FROM HERE THEY RUN DOWN
I. RAILS & HINGERS
J. RAILS & HINGERS
K. RAILS & HINGERS
L. RAILS & HINGERS
M. RAILS & HINGERS
N. RAILS & HINGERS
O. RAILS & HINGERS
P. RAILS & HINGERS
Q. RAILS & HINGERS
R. RAILS & HINGERS
S. RAILS & HINGERS
T. RAILS & HINGERS
U. RAILS & HINGERS
V. RAILS & HINGERS
W. RAILS & HINGERS
X. RAILS & HINGERS
Y. RAILS & HINGERS
Z. RAILS & HINGERS

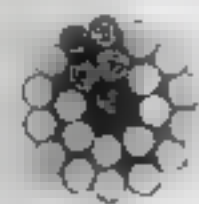
WINDING GEAR AND

N. STEAM ENGINE WITH
O. ENGINES, SCREW & W
P. RAILS & HINGERS
Q. RAILS & HINGERS
R. RAILS & HINGERS
S. RAILS & HINGERS
T. RAILS & HINGERS
U. RAILS & HINGERS
V. RAILS & HINGERS
W. RAILS & HINGERS
X. RAILS & HINGERS
Y. RAILS & HINGERS
Z. RAILS & HINGERS

THE ROPES.



LIFTING ROPE 1 1/2 IN THICK
A CORE OF TAPPED HEMP WIRE
B. 21 STRANDS OF GALVANIZED
STEEL WIRE. EACH STRAND
IS COMPOSED OF 3 LAYERS
OF WIRE. EACH STRAND
HAS A LENGTH OF
1025 FEET. WEIGHT IS 10 TONS AND
WILL NOT BREAK UNTIL A 230 TON
WEIGHT IS HUNG UPON IT.



TRAVERSING ROPE 1 1/2 INCH
THICK, OF SIMILAR MAKE.

THE PONTOON.

C. VERTICAL RAILS FOR
PASSAGE OF LIFTING
D. STEAM CAPTAINS
E. TWIN SCREWS GIVING
SPEED OF 3 1/2 KNOTS.
THE PONTOON IS DIVIDED INTO TWO
COMPARTMENTS, THE AFTER COW
HAVING SOME FIXED CONCRETE BALLAST
AND ADMITTING WATER BALLAST WHILE
MOVING, TO MAINTAIN EQUILIBRIUM.

This largest of floating cranes is at work in the Austrian navy yard. It carries two-hundred-and-forty ton loads of guns and machinery from the wharves to the battleships. In case of a submarine disaster near its station, however, it is the duty of the operators to answer the calls of distress. Under its own steam, the crane makes for the spot and sends down divers to find the submarine. Lifting the boat so the crew can escape, it deposits it on the barge to be carried to the repair dock

A Jeweler's Ruse for Making You Return His Watch

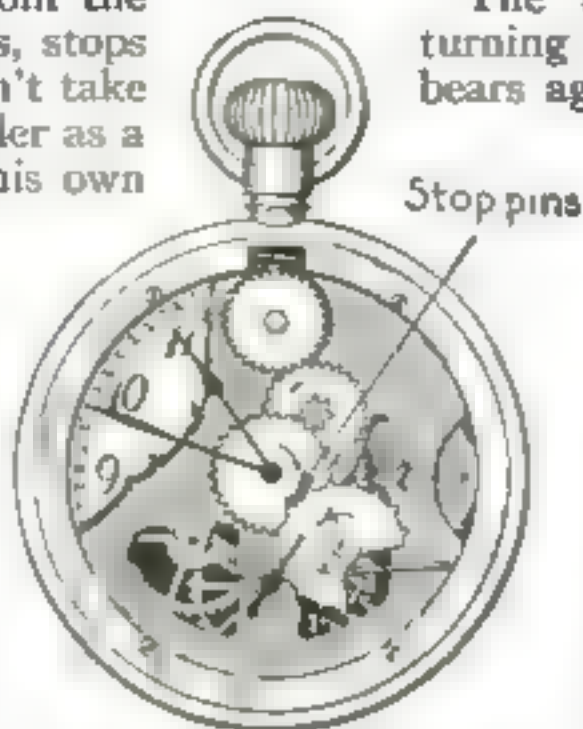
IF the watch you borrow from the jeweler while he fixes yours, stops at the end of a week or so, don't take it back and bawl out the jeweler as a man not even able to make his own watches run. He may smile a slow sad smile and tell you that your watch has been finished for nearly a week and that the bill is \$1.30.

A man who is just "ornery" enough to be a jeweler has patented a simple little addition to watches by which they will stop automatically, "never to run again," until the man who sets the attachment turns it off and again lets the watch tick merrily.

The jeweler in question sets forth that customers have the pleasant habit of borrowing watches while their own are being fixed and then wearing them for indefinite periods of time without returning to pay the little bill and take along the repaired watch. Apparently it peeves him, because he has designed a watch to act as before described—stop at the end of a predetermined time which

the jeweler feels is long enough for the customer to be wearing a watch not his property.

The trick depends upon a slow turning wheel with a stop-pin which bears against a sleeve on the second hand when the wheel has completed its revolution, thus stopping the watch.



The jeweler's watch with stop-pins to keep it from running well indefinitely

A Thriving Fishing Village That Floats

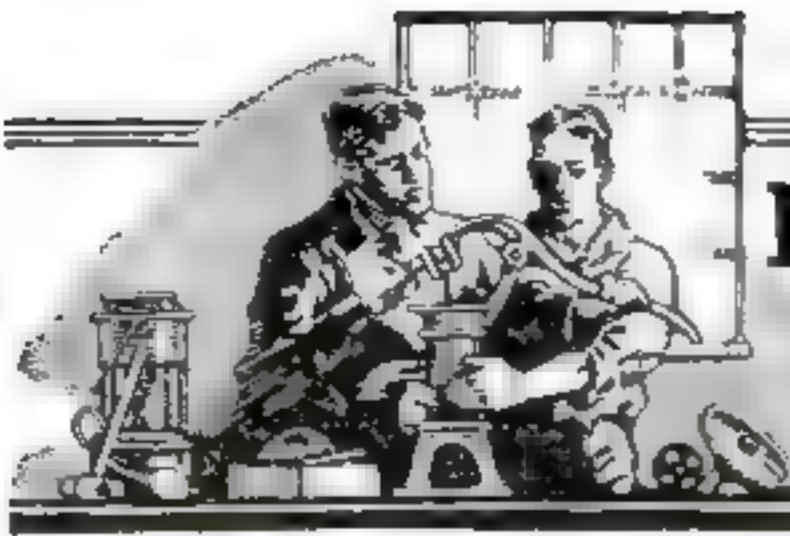
IN the shadow of the huge Manhattan Bridge which connects New York proper with Brooklyn, nestles a veritable fishing village consisting of nine two-story houseboats moored side by side so as to form a solid row and sheltering the fishermen, and their families, on whom New York

city is dependent for a good part of its fish supply.

But unless you are familiar with the vagaries of fish and the localities in which they school in certain seasons you need not go in search of this village. Often it disappears from a locality overnight, without any farewells, reappearing as quietly a few months later.



New York's floating fishing village consists of nine two-story houseboats moored side by side. Here the cargoes of the fishing boats from the surrounding waters are prepared for market



FOR PRACTICAL WORKERS

Flaps Used on Inner Tubes to Prevent Pinches

TIRE users do not generally realize the purpose of flaps and their influence in relation to the tire service. It is not customary to use flaps with clincher tires, not because it is unnecessary, but because of the difficulty in using a flap and stretching the tire on the rim so that it will fit properly. The beads of this type of tire are stretchable and are made approximately one inch less in diameter than the diameter of the rim, the object being to cause the tire to fit snugly to the rim, after being applied.

Several years ago it was a practice to use rim strips—a strip of fabric stretched tightly on the rim. These strips caused the beads to fit very snugly to clinches of the rim and protected the tube from rust and other damage. This was discontinued some time ago. While it is not necessary to use flaps with clincher tires of small size, it is really the proper thing to do with this type in sizes above 4 in., unless clips or spreaders are used to hold the beads tightly in the clinches of the rim so that the inner tubes will not be pinched or damaged. The beads of the quick detachable clincher cases and cables of straight side cases are non-stretchable and are, therefore, made to the approximate diameter of the rim.

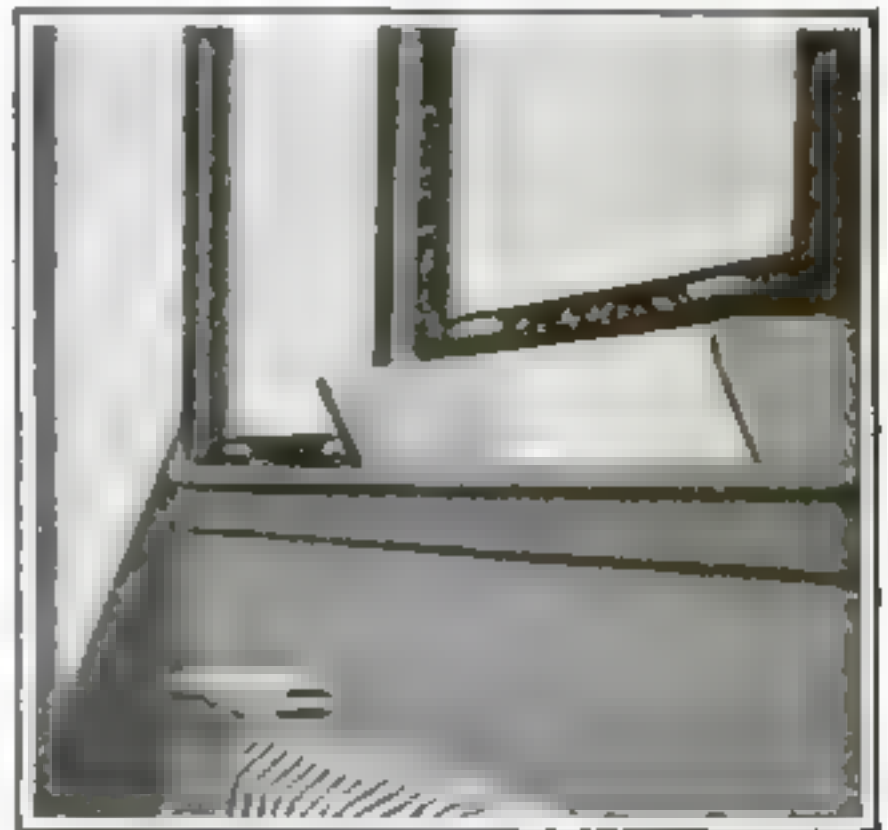
In former years tire manufacturers cemented the flaps to one side of the cases. The heat of the tire caused the flap to loosen, slip out of position, work under the beads, wrinkle and chafe the tubes. The floating flap, i. e., the flap loose in the case, proved to be more efficient in many respects. It is easier to apply the tire to the rim, the flap adjusts itself to suit conditions and, with reasonable caution, it is an easy matter to apply the tire so that the flap will stay in its correct position. The loose endless flap was then improved by splitting,

notching the ends in such a manner as to make the flap adjustable in circumference to accommodate variations in the circumference of the tire.

A Window Ventilator Which Eliminates Drafts

It is often inconvenient or unwise to open a window from the bottom for ventilation, on account of the disagreeable draft created. The illustration shows a simple method of eliminating the draft while still securing a plentiful supply of air. It is especially recommended for the sick-room or for a bedroom.

For each window, cut two pieces of $\frac{3}{4}$ -in. board as shown. These should be mounted



A glass set on a slope to direct the air currents upward as they enter the room

on either side of the window and fastened to the casement or sill. A groove at 60 deg angle is cut in the board for inserting a piece of glass, the length of the window and about $6\frac{1}{2}$ in. high. This allows the air to enter the room at an upward slant instead of directly.—J. C. GRINDELL.

Keeping Insects Away from Lunch Boxes

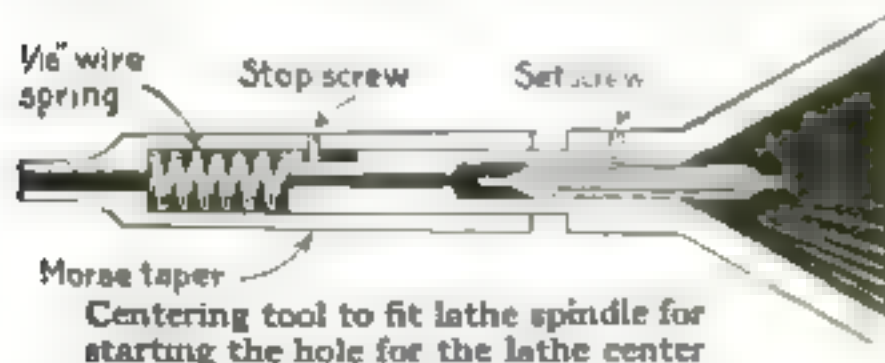
THE accompanying illustration explains a very efficient method for keeping ants and other insects out of lunch boxes. The oil cup consists of a one-pint tin soup can, cut off to the desired height. A piece of $\frac{1}{8}$ -in. galvanized wire is pushed through the center of the bottom of the can, where it is well soldered. Turn up a hook on each end, pour in a small portion of machine oil—any kind will do—and hang it on a nail in a cool place. Hang the lunch below it and it will be secure from insect invasion, for no insect will crawl farther than the oil.—L. M. DRAKE.



Wire with oil can for hanging lunch basket

The Construction of an Automatic Centering Tool

IN most up-to-date shops there will be found some sort of a saw that will cut a bar of steel reasonably square. With the tool illustrated the centering can be done by the apprentice and you will be surprised at the amount of work he can do in this way. The bell piece is of tool steel, thoroughly hardened. The small screw on the bell piece holds the center drill in place and is adjusted to the drill to the desired depth.



The end of the socket acts as a stop while the screw on the shank will keep the bell from sliding out of place. The shank is tapered to fit any lathe socket and works in conjunction with the bell center of the tail stock. It will center square bars as well as round stock providing the end is cut off perfectly square and at right angles to the length.—ROBERT J. SMITH.

Caution in Turning Corners to Prevent Tire Injury

BE careful in making sharp turns that the wheels do not cause the treads to be rubbed by spring shackles or other sharp projecting objects. If a bumper or guard is applied to the car front, be sure that the ends have enough clearance to prevent the tires from being gouged.

When the car is loaded heavily there is danger of tire treads being bumped or gouged by the fender when passing over rough places. Fenders that have been bent from accidents may be entirely too close to the tires and cause a great deal of injury, particularly if there are any sharp extending bolts underneath the fender. An inspection under fenders sometimes discloses bolts worn smooth and bright by continued buffing and rubbing by tires.

Making a Cigar Stand on the Top or Side of a Hat

THIS is an original pocket trick which may be performed anywhere and at any time. Borrow a hat—any kind, derby, soft felt, or straw—and a cigar. Place the cigar on the top or side of the hat and it will apparently stay there as if by your dexterous juggling or balancing. At command it will fall off and the cigar and hat can again be examined. All that is required to accomplish this clever conjuring feat is a common pin. Stick this pin in the thick flesh of your palm where it will stay unobserved. When the hat and cigar have been borrowed and examined place one hand beneath the hat (the hand containing the pin) and with the other hand steady the cigar as a juggler would when preparing to juggle some upright article. But while so doing stick the pin through the hat into the mouth end of the cigar. This will, of course, hold it upright. To cause it to fall, merely release the pin or pull it out and the cigar will topple over—the pin falls to the carpet. If not "overdone" you can always "get away" with this stunt as a genuine feat of juggling and no one will suspect the ruse employed.



The cigar stands on a pin run through the hat



Smoke Your Own Fish

Here is a simple method of constructing an inexpensive smokehouse suitable for smoking fish or meats

By A. M. Jungmann

TRY smoking your own fish if you have the space to put up a small smokehouse. It will be an interesting experiment as well as the means of obtaining wholesome and palatable food at a very small price.

There are many fishes of excellent food quality which ordinarily are discarded because their texture or flavor is not approved or because they are too bony. Such fish as bowfins, buffalo-fish, carp, mooneyes or sturgeons, of the fresh water fish, while not popular fresh, are excellent smoked. Bony fish acquire a firmness through smoking that makes the removal of the bones quite easy.

Fishermen frequently sell the less popular fish at from 1 to 3 cents a pound at the docks. A customer who might ordinarily buy only 2 or 3 pounds of the more expensive fish could buy, if he had a place to smoke them, enough cheap fish to last for one or two weeks. Also pond owners who desire to rid their ponds of ordinary fish in order to make room for game fish will find a smokehouse invaluable.

The United States Bureau of Fisheries constructed and operated a small experimental smokehouse on the Mississippi River. This house has proved most satisfactory in every way and its construction is so simple that anyone can build one along the same lines.

The house measures 6½ ft. in height at the front, 6 ft. at the back, the roof having a single pitch, and 3 by 3½ ft. inside measurements. If you build your house of plain boards it is necessary to prevent the escape of smoke by covering the cracks with batten strips. If you can get yellow pine shiplap you can make your house smoke-tight without using battens. The 2 by 4-in. corner pieces may be on the out-

side, the inside walls being perfectly smooth.

Two doors are built in the upper half of the front of the house. They are hung on the corner pieces. The outer edge of the right door should be fitted with a batten that overlaps the other door. This holds it shut and prevents the escape of smoke. The doors may be fastened by two wooden thumb buttons, one above and one below the battened door, near where the two doors join and just beyond the batten.



The inner walls have strips on which to place the trays holding the fish to be smoked

Ventilation is provided by an opening in the roof over which a ventilator is placed. The ventilator is a box having a 3 by 4 in. opening front and back. This permits the

escape of smoke and moisture. A slide damper controls the escape of smoke and assists in regulating the draft of the fire.

The house is finished on the inside with 2-in. square strips nailed to the sides near the top, and rabbeted cleats or plain strips are nailed to the sides some 4 to 6 in. apart. These strips should not be leveled. They should have a slope of 6 in. toward the front of the house. When trays holding the fish are placed on them this slope will enable the fish to drain while smoking.

Several removable wire trays should be made to slide on the rabbeted cleats.

Fish not put on trays are hung from the horizontal rods of wood or iron which extend across the house from side to side.

To insure successful smoking it is most important that the smoke spreader be properly constructed. This is a rectangular iron box 1 ft. square and 2 ft. long. Holes $\frac{3}{4}$ in. in diameter should be punched in the sides and ends at frequent intervals to induce the smoke to spread evenly throughout the house.

Dig a trench from the house 7 ft. long, 8 in. wide and 8 in. deep. Place in this trench three sections of ordinary stove-pipe, fitted at one end with an elbow. In the middle joint of the pipe place a stove-pipe damper. As the handle will be too short, fit it with an extension so the damper may be operated from above when the pipe is covered with earth. This damper is very important as it is the principal fire and smoke control. The pipe is lightly covered with earth. The elbow projects upward into the house under the smoke spreader extending about 2 in. above the surface of the ground.

The firebox, which is at the other end of the pipe, is sunken. It is 14 in. wide, 14 in. deep and 24 in. long. It should be built of brick and covered with a heavy piece of sheet metal, which in turn is covered with earth. Firing is made easier by having a sloping trench in front of the firebox. After the firebox and flue are completed and the house is set over the open end of the

elbow, earth should be banked carefully all around the bottom of the house to prevent outside drafts.

Before smoking, fish should be split and the entrails removed. A fish having a dark abdominal lining should be scraped until the lining is removed. It is not necessary to do anything further with small fish before placing them in the brine. Large fish, however, if they are above 2 lb. in weight, should be split down the back from the inside, severing the ribs close to the backbone. They should be so split that they will lie flat. Very large fish should

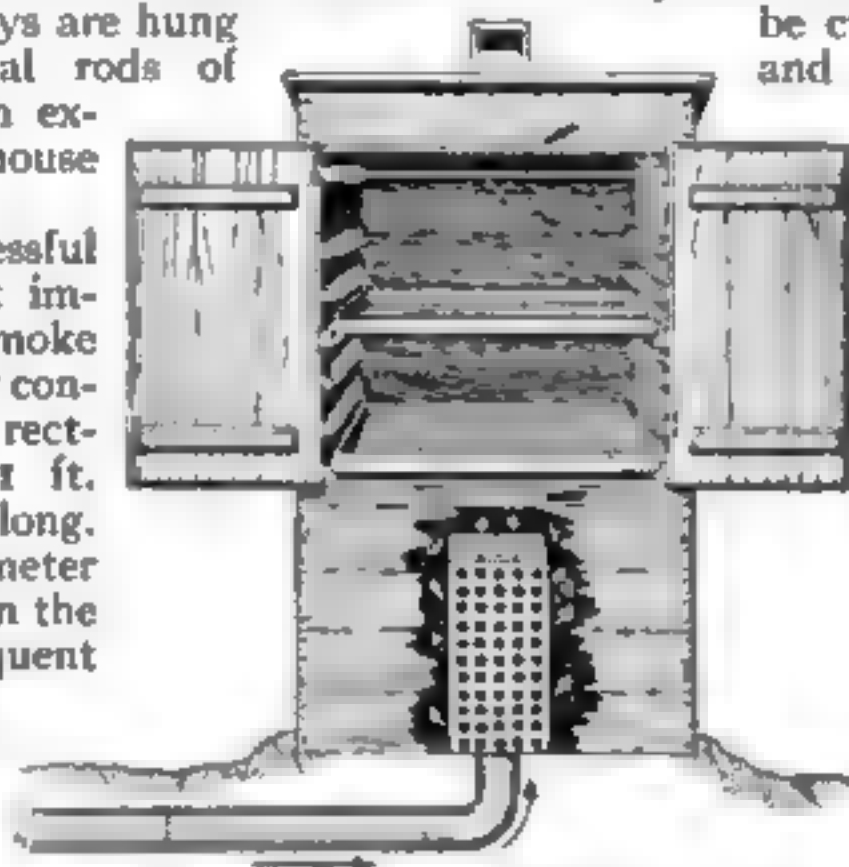
be cut in two or more lengths and split in the same way.

This must be done to permit the salt to penetrate and to make the fish smoke evenly.

Brine is prepared by dissolving common barrel salt in fresh water until it will float an egg. Place the fish in the brine, scale side down, and leave them over night. When taken from the brine they should be washed in fresh water and placed on sloping trays or hung up to dry. Fish should be dried for a short time before smoking.

Some fish are so soft that they cannot be hung by wires to smoke. These should be placed on trays, skin side down. Firmer fish are hung in wire slings from the rods at the top of the smokehouse.

The best fuel for smoking is green hickory. It gives off a clear white smoke and colors the fish a rich, golden brown. The flavor imparted by hickory smoke is superior to that produced by any other wood. Next to hickory come corn cobs. While they give off dense smoke which darkens the product too much, they impart a flavor which is very fine. Dry oak discolors the fish a little too much and gives it a mild acid flavor. Soft and hard maple are used, but these burn too freely. However, the maple has a flavor much liked by some people. Green ash gives off a light smoke and the flavor is similar to that produced by hickory. Green willow is excellent used with other woods as it gives an abundance of smoke. Sawdust may be



To insure successful smoking it is important to have a properly constructed smoke spreader

used for dampening the fire, but does not burn freely enough alone to give the requisite heat.

Under no circumstances use pine wood, because the smoke gives a resinous flavor to the fish and renders it most unpleasant to the taste. A very small amount of pine wood may be used with other woods if no better fuel is available.

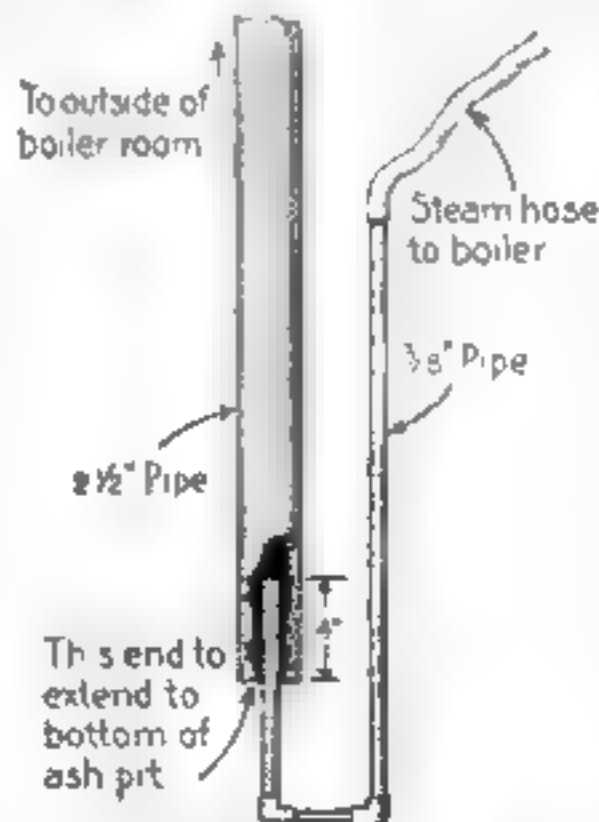
The smoking process is very simple, but it requires care and patience. Fish should be smoked from 24 to 36 hours, depending on their size. Some small fish need only 6 to 8 hours. Care should be taken not to allow the fire to get too hot as too much heat makes the product dry and unattractive. At first it is well to test the fish by tearing off small pieces while they are smoking.

When the fish are properly smoked they should be left in the smokehouse until cold. If they are taken out while hot they are almost sure to sweat. This causes molding. They should be kept in a cool, dry place as an insurance against mold. It is a good idea to dip them in melted paraffin as a protective measure. They should be handled very little after this.

Simple Ejector for Removing Water from an Ash Pit

CONSIDERABLE trouble was experienced in a boiler room with a leaky valve, the location of which caused the water to run in the ash pit. This had to be bailed out, and the fireman had all he could do, until the repair was made, removing the water with a bucket. Being gifted with some ingenuity he devised the ejector shown in the illustration. A piece of $2\frac{1}{2}$ -in. pipe long enough to reach out of the boiler room was placed so that one end entered the pit while the other remained in the water.

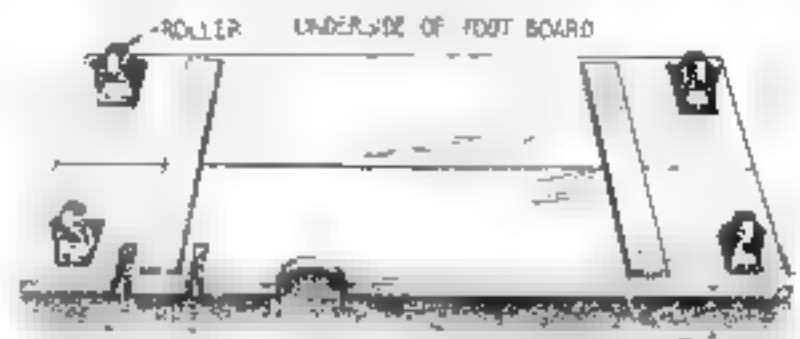
A length of $\frac{3}{8}$ -in. pipe was bent into a U-shape, one end being introduced in the large pipe in the water and the other attached to a steam line. With this appliance which only required a few minutes to make, and which cost practically nothing, the water was soon removed.—CHARLES LOOMIS.



A simple and inexpensive ejector made of pipe and fittings

Automobile Footboard Used as a Roller Board

THE footboard of an automobile can be readily made into a roller board convenient for making investigations under the car whether in the garage or on a country



The footboard with rollers attached makes a good roller board for use under automobile

road. It is only necessary to attach a ball-bearing roller or caster on the underside of the board at each corner where they will not be likely to interfere with any part of the motor.—LOUIS S. NIPER.

A New Way to Make an Hydraulic Test for Steam Boilers

SOME time ago, the writer desired to test a small upright boiler that had frozen up during a cold snap. Having no force pump to give it the hydraulic test of 100 lb. pressure per square inch, he finally hit upon the following method which proved very effective:

The boiler was filled completely with water, leaving no air space whatever; then a small fire was built so as to heat the water gradually. This caused the water to expand and register pressure on the gage. When the desired amount of 100 lb was reached, a try-cock was opened and the water allowed to reach the proper working level. Everything being found in good working order, the fire was increased and the necessary amount of steam was then gotten up in the usual way.

It is best always to thaw a frozen boiler out completely before trying any tests of this kind, making sure that all of the pipes are free from ice, and everything in good condition; otherwise serious accidents may result.—W. S. STAUDIFORD.

Some Common Abrasives

By Professor William Noyes

Late Director of the Department of Wood-Working, Teachers' College, Columbia University,
and author of "Hand Work in Wood"

WOOD may be either cut down with an edged tool or worn down by abrasives. The common abrasives are steel, a hard mineral, or a mineral-like artificial substance.

Steel is used for rubbing in two main forms: as a file or rasp, and in the shape of steel wool. The teeth of a file are cut when the metal is soft and cold. The tool is then highly tempered, so that the metal becomes very hard and brittle. At least three thousand varieties of files are made, each adapted to its particular purpose. They are used chiefly for scraping the surface of metal, but are also applicable to wood for certain purposes.

Files are classified (1) according to their outlines into taper and blunt, (that is, having a uniform cross-section throughout); (2) according to the shape of their cross-section into flat, square, three square or triangular, knife, round or rat-tail, half-round,

etc.; (3) according to the manner of their serrations, into single-cut or "float" (having single, unbroken, parallel chisel cuts across the surface),

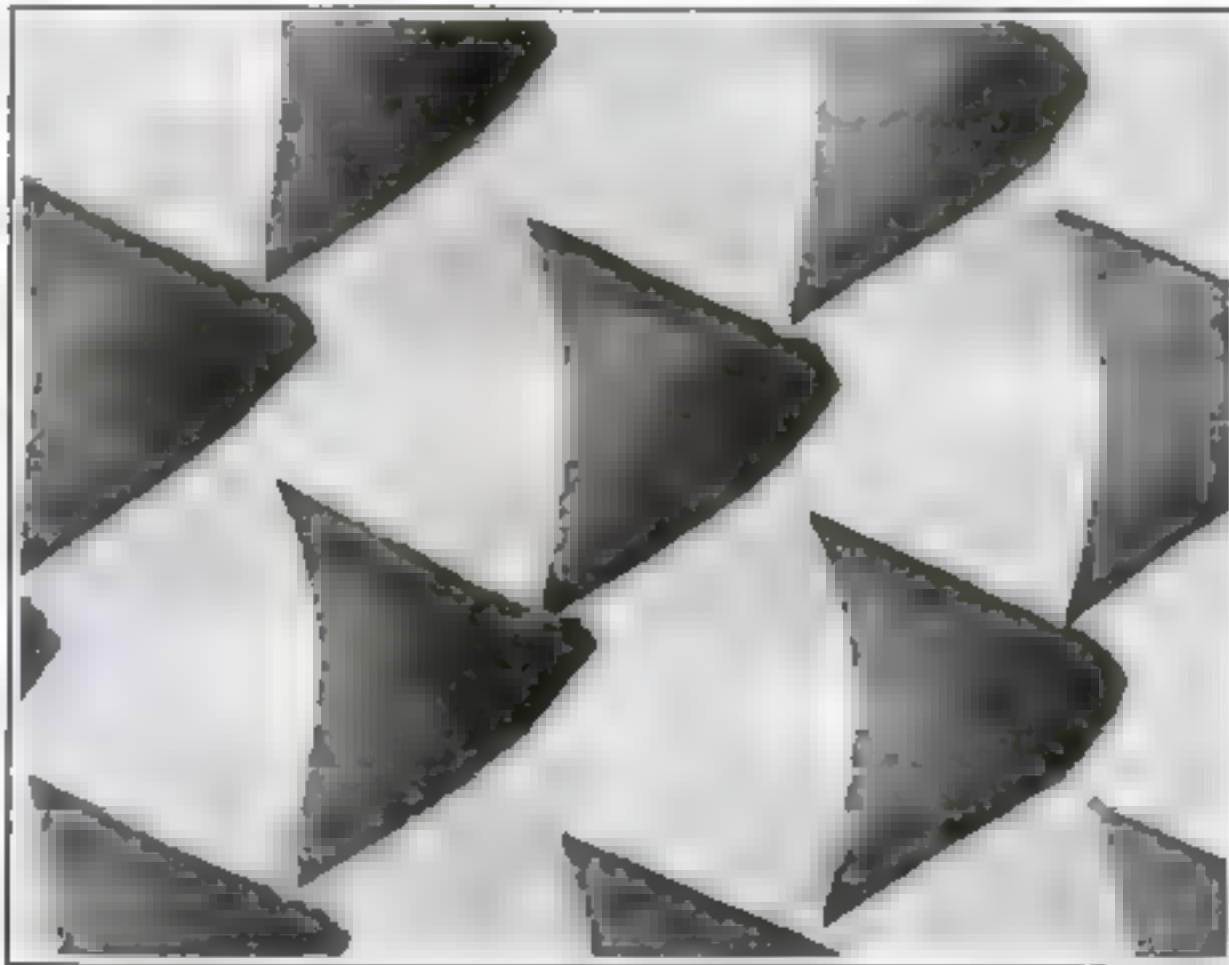
double-cut, (having two sets of chisel cuts, crossing each other obliquely), open-cut, (having series of parallel cuts slightly staggered), and safe edge or safe side, having one or more uncut surfaces; and (4) according to the fineness of the cut (rough, bastard,

second cut, smooth, and dead smooth). The "mill file," a very common form, is a flat, tapered, single cut file.

One of the two sides of a carpenter's rasp is shown magnified in the illustration.

The fine or flat side is composed of a series of edges, made by cutting lines, whereas the rough, half round side is made by cutting indentations with a triangular point.

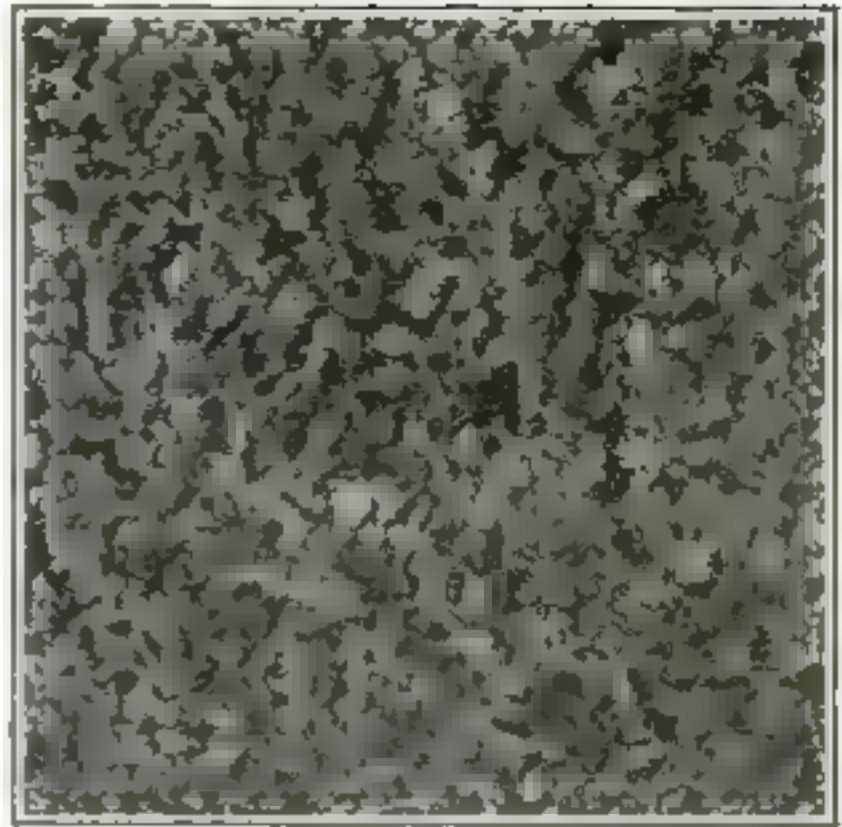
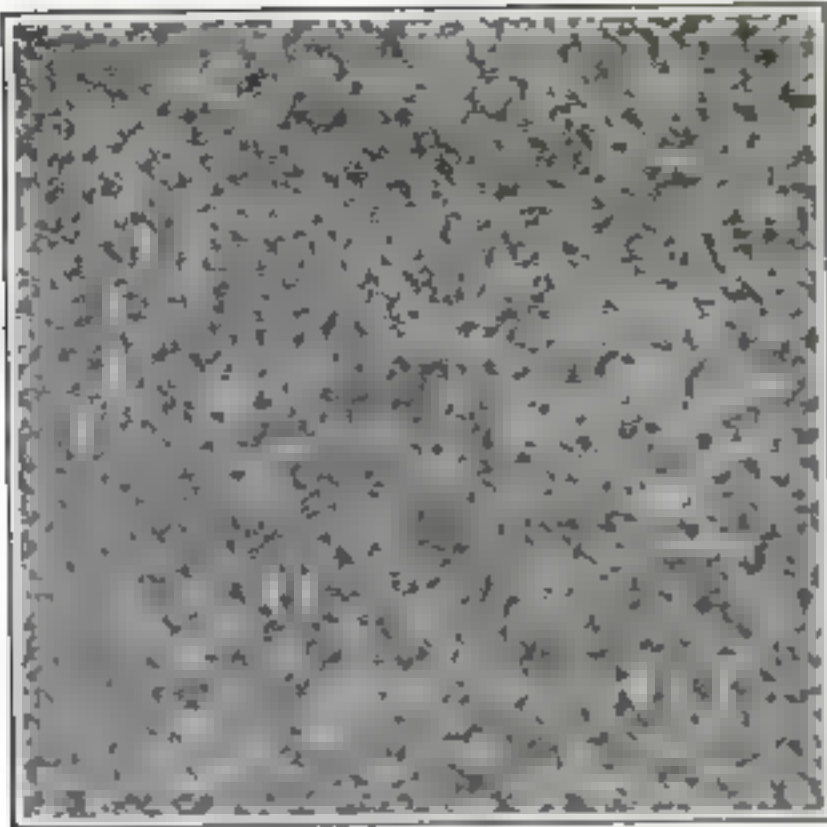
Steel wool is shaved from thin disks of steel held together in a lathe. There are various grades of coarse-



The coarse side of a carpenter's rasp magnified showing the indentations cut with a triangular point of a hardened piece of steel



Steel wool shaved from the edges of thin steel disks



An abrasive made by fastening sharp sand, graded according to degrees of fineness, to paper with an elastic adhesive. The paper may have a grain or the fibers may be distributed generally

ness, from No. 00 to No. 3, the latter being about equivalent to sandpaper No. 2. Steel wool has a number of uses. It is a substitute for sandpaper, especially on curved surfaces, and it is useful in rubbing down paint and shellac. Like sandpaper it should not be used until all the work with cutting tools is done. It can be manipulated until utterly worn out. Other steel abrasives are: steel emery and crushed steel, and highly tempered steel. Steel emery is the harder of the two, being nearly as hard as diamond. They are used in stone sawing, the grinding of glass, and in lithography.

Sandpaper

Sandpaper is made of two special kinds of paper—cylinder and Fourdrinier paper. Cylinder paper has a grain; that is, the fibers lie in one direction, so that the paper tears easily in that direction. Fourdrinier paper will not tear readily in a straight line, because the fibers are distributed to give strength in every direction. The glue used to fasten the "sand" on the paper must be very elastic,

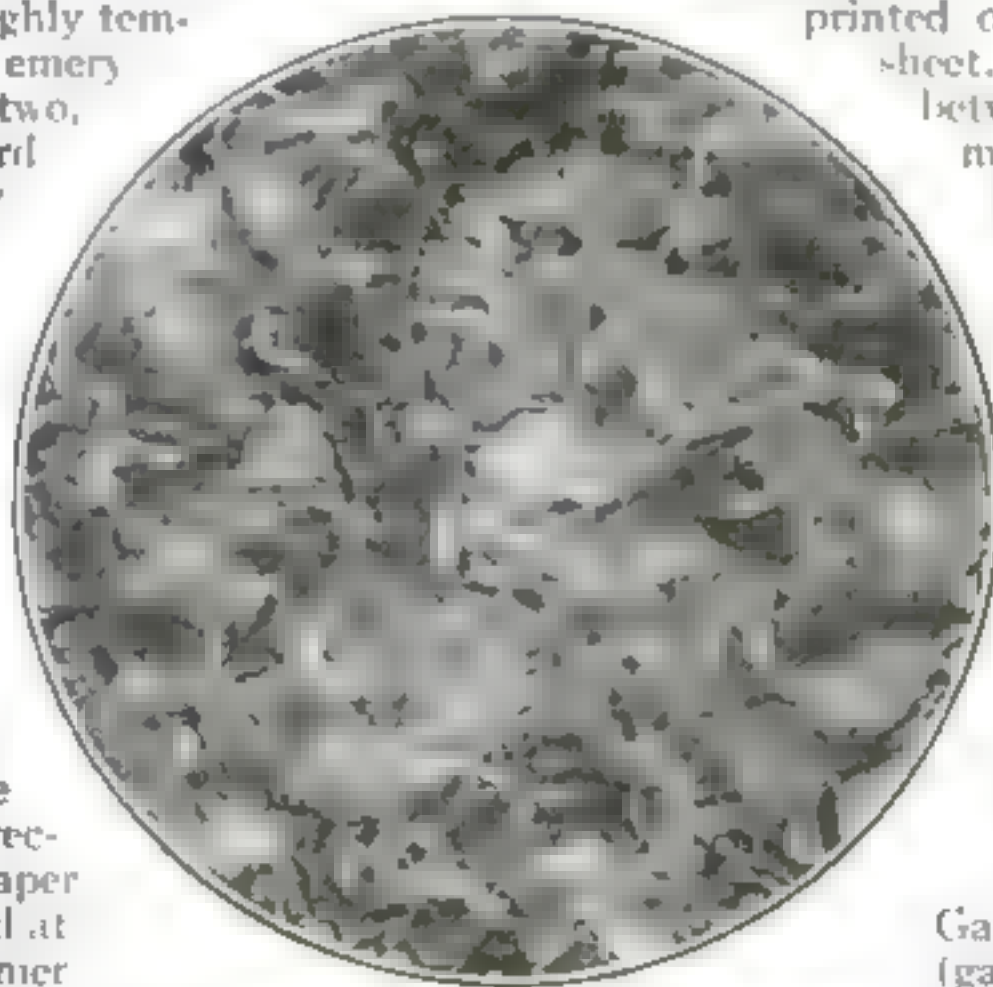
and hence of a fine quality. It also serves to strengthen the paper. The "sand" of sandpaper is crushed flint or quartz rock, and each particle of it is hard and sharp. This sand is carefully sifted and graded, so that sandpaper can be made in various grades according to the coarseness of the sand. The standards of coarseness are Nos. 4-0, 3-0, 2-0, 0, $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$ and 4. These grades are printed on the back of each sheet. The difference between fine and coarse may be seen in the illustrations.

Sandpaper has a disadvantage. With use, the corners of the grains of sand soon wear smooth, so that it does not last long. For this reason, it has been displaced by garnet-paper in many instances.

Garnet-Paper

Garnet is a natural rock, (garnet ore), which is largely quarried in the Adirondack Mountains in New York State.

It is crushed, sifted and measured, like the sand of sandpaper. It may be mounted, (glued) on a paper backing, for hand use, but



Garnet-paper is made from natural rock crushed and sifted on glue-coated paper

when it is to be used in sanding machines, there is an additional backing of cloth. Garnet-paper is not so sharp as sandpaper, but it has the advantage that the edges and corners of the particles do not wear smooth, but break off at sharp angles. Hence it cuts satisfactorily just so long as it adheres to the paper.

Emery

Emery is a variety of corundum, and is second only to the diamond in hardness. When used for the abrasion of metals, it may be spread on the surface of paper, cloth, or wood. In this shape it is used mostly for smoothing and polishing metal. Emery may also be mixed with a kind of earthenware, and then baked, to make "emery stone." Emery wheels are thus made, and they are so hard and strong that they can be revolved at a high velocity, to cut very effectively. Emery in its powdered form is used to grind valves to their seats and to make them airtight.

Whetstones are quarried and cut from natural rocks, found mostly in Arkansas. The best ones are found near Hot Springs, Ark. The coarser ones, such as are used for whetting scythes, etc., are called Washita stones, while the fine white ones are called Arkansas stones.

Other natural abrasives used in the arts are tripoli, made from a silicious sandstone, and used for polishing horn, shell and metal; rotten stone, an infusorial earth, used in rubbing down varnish; pumice, made from a volcanic ash, also used in rubbing down varnish; and rouge, made from sulphate of iron, and used for polishing glass. It will be observed that all of the abrasives mentioned are mineral products except the steel wool.

Half-Soling Rubber Overshoes to Give Longer Wear

AS rubber overshoes are still in high favor as a necessary evil for keeping the feet dry in muddy or wet weather, any idea that promises to make the rubber give longer service should appeal to economical people.

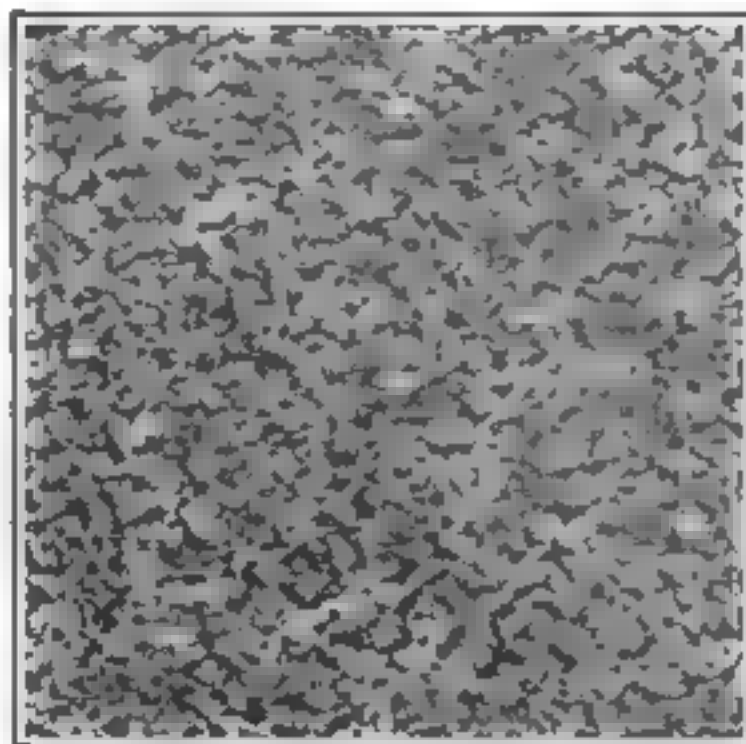
A friend of the writer gets more than double wear out of his rubber overshoes by half-soling them with rubber. He owns an automobile, and when the soles of his overshoes become thin, but are still watertight, he takes a torn and otherwise useless inner tube and cuts a half-sole from it. This half-sole is then cemented to the rubber shoe—after both sole and shoe have been cleaned thoroughly and roughened with sandpaper—using ordinary rubber cement

and clamping or holding both tightly together so that a secure union is obtained. The same kind of cement is used as for repairing bicycle tires, and if used according to the directions that accompany it, a satisfactory job will result.

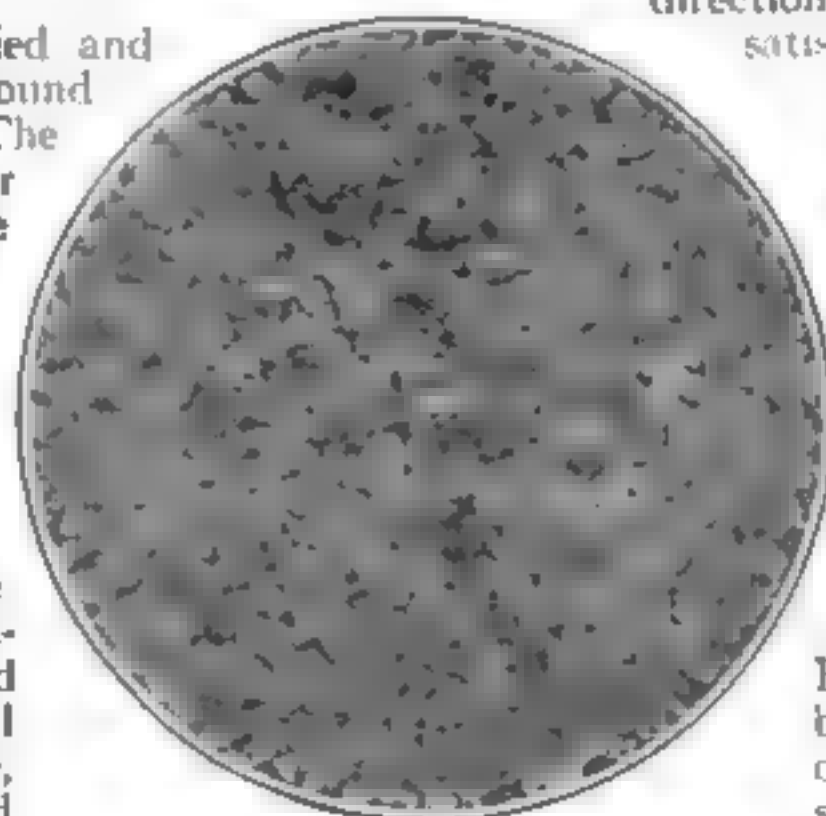
An attached sole of this kind will often give longer wear than the original. If the heels also are worn, they can be repaired in the same manner. If you cannot procure an old rubber inner tube, most any kind of pliable sheet rubber will do, providing it is of the proper thickness. Halfsoles for arctics have been made from a piece of large-size rubber hose, split and straightened, and have given excellent service. The rubber used for this purpose must not

be hardened from age.

If it is not possible to procure an old piece of rubber, an extra half-sole or heel can be purchased from a rubber dealer. These come in different sizes and shapes.



Whetstones are quarried and cut from natural rocks found mostly in Arkansas



Emery is second only to the diamond in hardness. It is the strongest abrasive

Simple Designs for Sheet Metal Working

VI.—Method of developing patterns for elbows of various shapes

By Arthur F. Payne

Director of Vocational Education

TO the students who have been following and working out the problems in this series of articles, the six elbows drawn and described will be simple to develop. The first three—the square, oblong and oval elbows—are in common

tom *B*. It will be necessary to develop the pattern for one piece of the elbow, the same as in the round elbow. In this case the pattern is developed for the part marked *A*. The seam is indicated in the center of the short side of the elbow (see bottom view *B*). Moving clockwise around the bottom view, number each point 1, 2, 3, 4, 5 and 6 as shown. Lay off the base line *C-D*, finding the correct length by taking the distance 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 6, from the bottom view *B*. Run these points upward from the base line as indicated by the faint lines, then from the joint line project

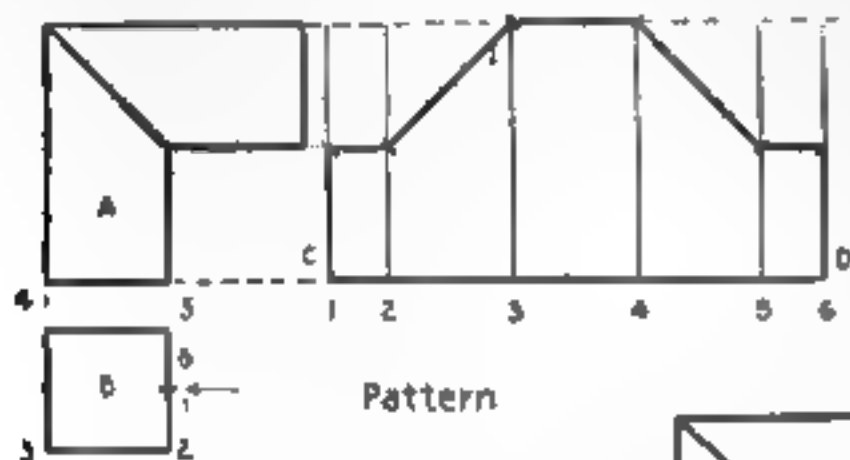


Fig. 1

everyday use. The others are more uncommon, and are used in special cases for special purposes. These will make good exhibit pieces to place in shop windows as a proof of ability to develop and make unusual pieces. The patterns for all of these six elbows are developed

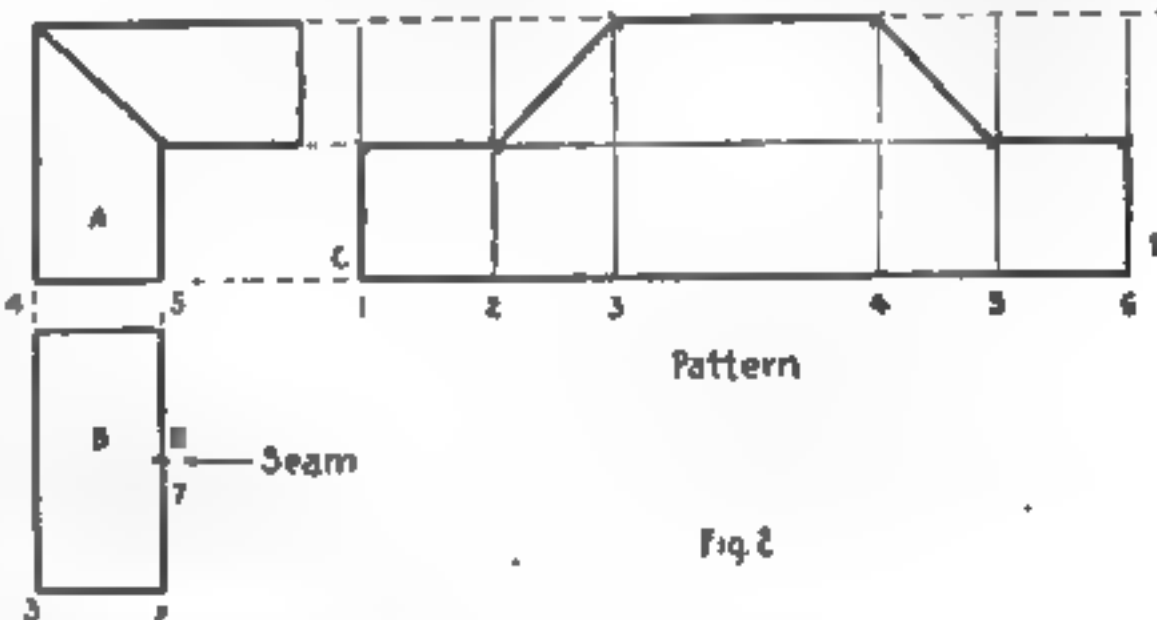


Fig. 2

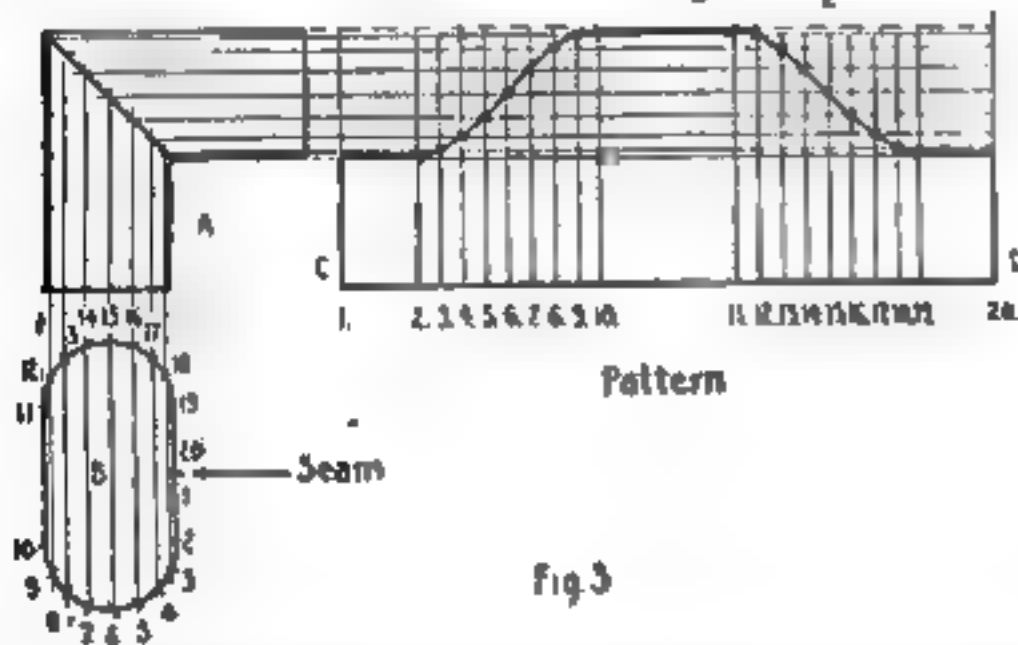


Fig. 3

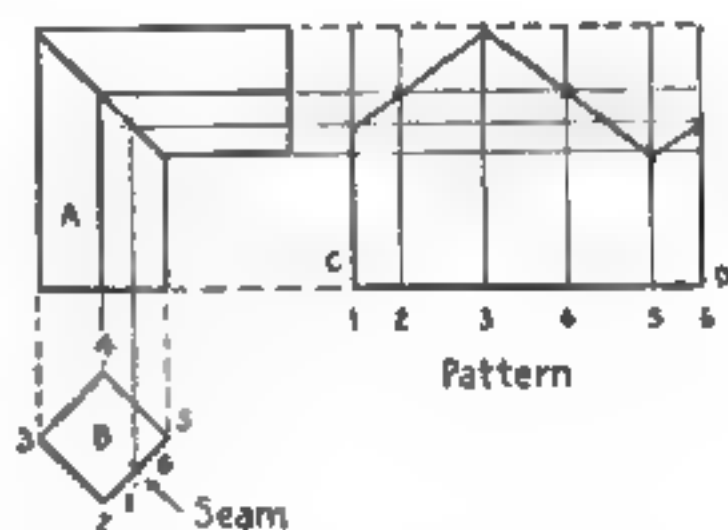


Fig. 4

The square, the oblong and the oval elbows are in common everyday use and the method for their development is exactly the same as that for making the pattern for the ordinary round elbow

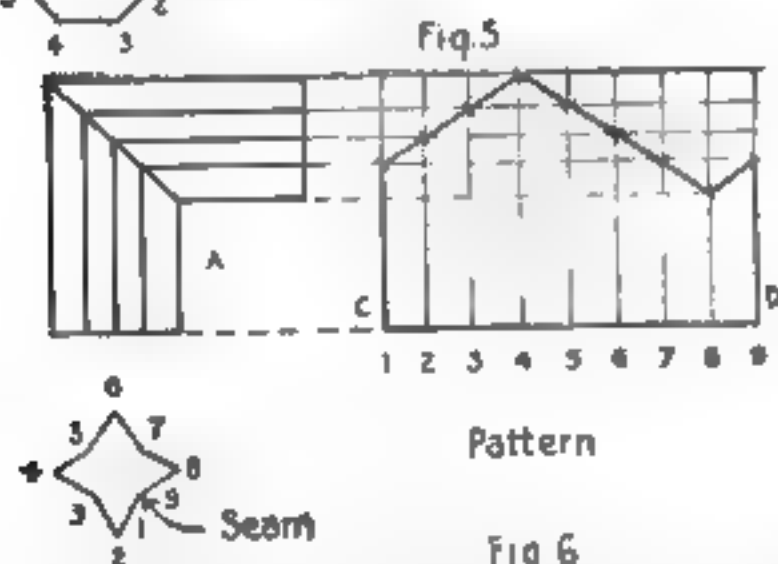
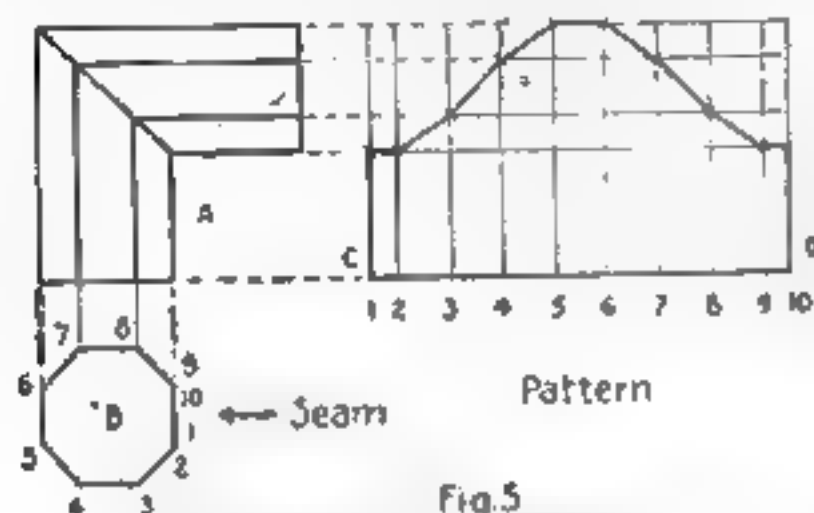
in exactly the same way as the pattern for the ordinary round elbow illustrated in the first article of the series (June, 1917, issue).

The square elbow, Fig. 1, is the simplest to make. First, draw a front view of the elbow shown at *A* and then draw the bot-

tom view *B*. It will be necessary to develop the pattern for one piece of the elbow, the same as in the round elbow. In this case the pattern is developed for the part marked *A*. The seam is indicated in the center of the short side of the elbow (see bottom view *B*). Moving clockwise around the bottom view, number each point 1, 2, 3, 4, 5 and 6 as shown. Lay off the base line *C-D*, finding the correct length by taking the distance 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 6, from the bottom view *B*. Run these points upward from the base line as indicated by the faint lines, then from the joint line project

ance must be made on the pattern for the locked seam on the seam edges and also for a lap seam where the two pieces of pipe meet at the joint line.

The oblong pipe, Fig. 2, is worked out in exactly the same way. The pattern for the



These elbows are used only in special places and for making an exhibit of the shop's work

oval pipe, Fig. 3, is developed by a combination of two simple methods that may prove to be somewhat confusing unless carefully worked out. One of the methods is used in developing the pattern for the round elbow in connection with the one just described for the oblong elbow. As usual draw the front view A; next the bottom view B. Make the seam as indicated, number it 1, then where the half-circle on the end begins, mark that point No. 2. Divide the half-circle into eight equal parts as indicated. Repeat this operation on the half-circle on the other end. Number all points consecutively from 1 to 20. Transfer the distance between these points to the base line C-D. Project these points upward, then as usual project the points from the bottom view upward to the joint line on the front view and then over to the pattern until the line intersects with the similarly numbered line coming up from the base line. Make a cross at these points of intersection and connect them with a free hand curve, which will give the complete pattern. Make allowance for seams and laps.

The patterns for Fig. 4, 5 and 6 elbows are

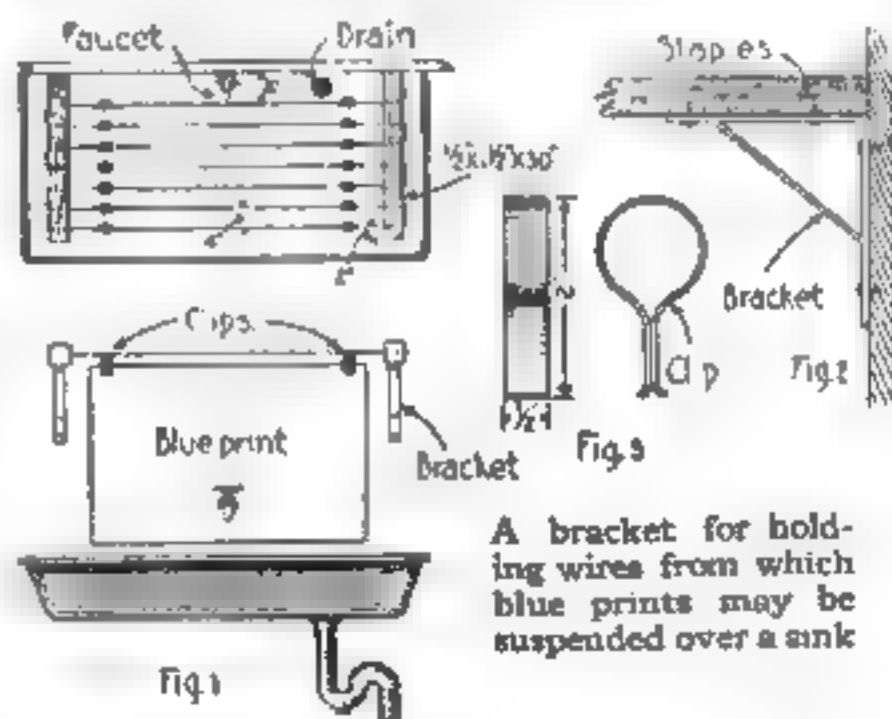
developed in exactly the same way. The steps are: (1) Draw elevation marked A. (2) Draw the bottom view marked B. (3) Space the bottom view. (4) Draw the base line C-D. (5) Transfer the spaces from the bottom view B to the base line C-D. (6) Project upward the points from the base line. (7) Project points from the bottom view B upward until they intersect with the similarly numbered lines coming up from the base lines C-D. (8) Make allowance for the locked seam and for the lap seam where the two pieces of pipe meet.

Table Leg Sliders Made of Shotgun Shell Wads

GOOD noiseless sliding casters or domes can be made for chairs and tables by taking some heavy felt or fiber shotgun shell wads and securing one to the bottom of each chair or table leg, tacking through the side of it with carpet tacks, or small finishing nails.—H. K. CAPPO.

Blue Print Drying Rack to Hang Over Sink

A NEAT and inexpensive blue print drying rack can be made as follows: First obtain two pieces of wood $1\frac{1}{2}$ in. square by 30 in. long and drill holes in them 4 in. apart and large enough to admit a No.



22-gage wire, as shown in Fig. 1. Two iron brackets fastened to the wall by wood screws hold the two pieces in place. The frame is now wired as indicated, and the ends of the wire fastened by staples as shown in Fig. 2. The clip, Fig. 3, is of spring phosphor bronze. Two of these are required for each wire for holding the prints.—FRANK HARAZIM.

Simple Die Casting for the Home Shop

A SIMPLE and easily made mold for the use of the home mechanic is shown in the illustration. It consists of a length of tubing of any convenient material, cut longitudinally into two equal parts. Steel caps fit close over both ends of the two parts of the tubes, holding them firmly together and in line. In use, one-half of the shell is first filled with plaster of Paris, a block of wood being used at each end to retain the plaster. The pattern, having been oiled with lard, or with graphite-filled oil, is embedded halfway in the plaster. After the plaster is set, the surface of the first half of the shell is carefully wiped over with graphite, and then the second half is filled in the same way. The parts thus placed together are all capped and put away to set.

When the plaster has set and become dry the caps are removed, the tube taken apart, and the pattern removed. The core *A* is now set and the pouring gate *B* and riser *C* are cut in the plaster. The parts are then put together and the caps replaced. The mold is then ready.

The great advantage of this mold is that its alinement is positive and automatic. This mold is intended for white metal, pewter and metals fusing at low temperatures. The drawing shows how the gates and risers should be located with reference to the pattern in all castings. If the mold is well dusted with graphite before each cast, and a proper number of cores supplied, a number of castings can be made from it.

This mold is especially adapted for making metal patterns to take the place of wood.—J. B. MURPHY.

Expansion Shield for Screws Made of Sheet Lead

A VERY good expansion shield is made from sheet lead rolled up to such a size as to snugly fit the hole.

Painting on Cemented or Concrete Surfaces

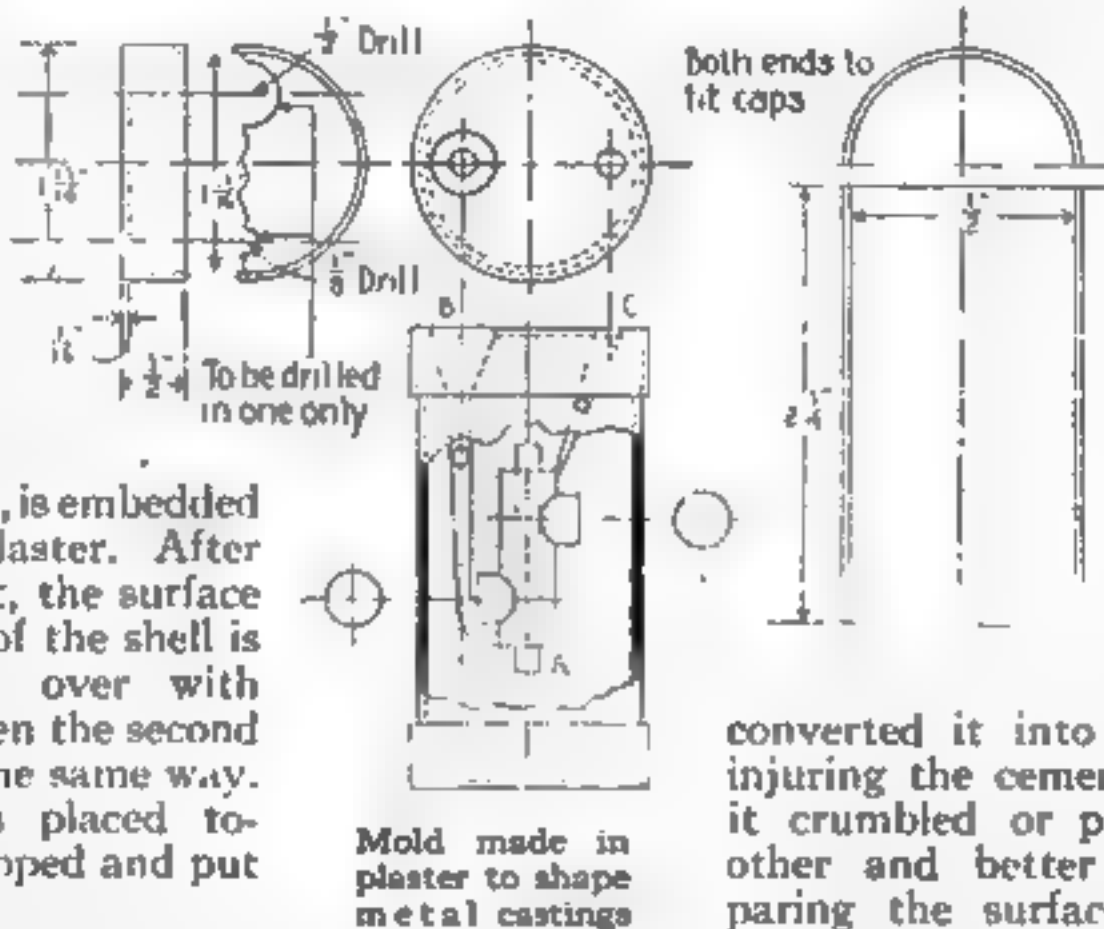
WHEN paint is applied directly to cemented surfaces the free lime in the cement will saponify the oil of the paint and destroy its integrity so that finally the paint will peel off. After such a surface has been exposed to the elements for about a year, paint may be applied with little danger of deterioration. But this is not sure.

One of the early processes for neutralizing the free lime was by the use of dilute muriatic acid of 7 or 8 per cent of concentration mixed with water. But it was soon found that the acid used to neutralize the lime

converted it into calcium chloride, injuring the cement surface so that it crumbled or pitted badly. Another and better method of preparing the surface consists in the application of carbonate of ammonia, 10 lb. to 45 gal. of water. Insoluble calcium carbonate was formed and a large amount of ammonia was liberated. This preparation does not injure the surface of the cement. When used on a mortar plaster containing lime, as in building a stucco house, it is better to apply two weak solutions of this kind, rather than one strong solution.

But the best treatment is with zinc sulphate, used with water of equal weight. This wash is put on with a brush having stiff bristles. The chemical effect is in changing the caustic lime into calcium sulphate or gypsum, and zinc oxide is formed in the pores of the cement. This treatment has no injurious effect on the cement surface; on the contrary it makes it fit to take and hold the paint. This method of preparing cement for paint has been well tried out and is reliable.

The following formula for painting on concrete or cement may safely be followed: For the first or priming coat, after the surface has been sized with the zinc sulphate solution and is dry, mix 100 lb. pure car-



bonate of lead, 4 gal. genuine kettle boiled linseed oil, or 9 gal. pure raw linseed oil, with $3\frac{1}{2}$ pt. of Japan dryer and 1 gal. of turpentine. The second coat consists of 100 lb. carbonate of lead, 4 gal. pure linseed oil ($\frac{1}{3}$ boiled and $\frac{2}{3}$ raw) or 4 gal. pure raw linseed oil and 1 pt. of turpentine dryer. The finishing coat is prepared from 100 lb. carbonate of lead, $3\frac{1}{2}$ gal. pure linseed oil ($\frac{1}{3}$ boiled and $\frac{2}{3}$ raw, or $3\frac{1}{2}$ gal. pure raw linseed oil and 1 pt. turpentine Japan dryer) and 1 pt. of pure gum turpentine. All these ingredients should be the purest and best of their kind. Inferior materials are likely to give unsatisfactory results. Zinc white is too hard for concrete painting.

Red lead is a very good pigment for the first coat on cement. It is more impervious to water than white lead, is elastic, and dries well. But if light color is to be placed on it there is likelihood of the red staining the light coat, unless a heavy second coat is applied.

As certain pigments are affected by an alkali, only those immune to lime should be used in painting over cement. For buff use yellow ochre; for a light yellow use zinc yellow (zinc chromate); for red use red ochre or bright iron oxide; for blue use ultramarine blue, preferably the sulphate ultramarine; for green use ultramarine green or oxide of chromium green; for white use zinc sulphite (lithopone), zinc white not being desirable on account of its hardness or lack of elasticity; for black use mineral black, black oxide of manganese, black oxide of iron; for gray use graphite and lithopone, or lithopone and mineral black. All earth pigments are safe with lime; Venetian red gives a pleasing color.

In painting on cement it is customary to use plenty of turpentine, rather than much oil. Also very little dryer should be used. By using boiled oil we escape the use of dryers entirely. Some painters use all turpentine for the thinning of the first coat, or nearly all, with little oil, though the oil is increased with each successive coat of paint. If the finish is to be dead or without luster the first coat is thinned with turpentine only, making the paint very thin, adding a little varnish as a binder. The next coat is similar. The third coat should be thinned with 3 parts boiled linseed oil and 1 part turpentine. The finishing coat is thinned out with turpentine, with a little varnish as a binder.

A number of special coatings for cement

are on the market, guaranteed by the makers to be proof against alkali. The waterproofing qualities of some of these preparations are overdrawn. To test such a liquid, take a fairly porous brick and apply to it as many coats as would be placed on the cemented surface; but two coats are better than one in any case, particularly where a very light color is to be used. Let the brick dry, then weigh it, make a note of the weight, then place the brick in a vessel with water just sufficient to cover the brick; after about one-half day remove brick, wipe off moisture, again weigh it, and compare with weight previously noted. The difference in weights will show amount of water taken in through the paint.

Try different paints. The one that shows the greatest water-resisting power is the one to use. Where concrete silos are used, a waterproof paint is useful. On the inside it prevents the liquid from the ensilage from soaking into the wall, and as silage is acid this would injure the coating of cement. Tar is often used as a coating for this purpose, and it does very well.

Besides the colored coatings there are a number of so-called colorless waterproof cement coatings on the market. These are intended for use where the color of the cement is to be preserved. They are also largely used as a preservative for limestone, sandstone, etc. The oldest used preservative for this purpose is paraffin, applied hot with a brush. Concerning the usefulness of the colorless liquid coatings, some of them are of some value in retarding moisture, but all are found lacking in the following respects: They emphasize any defects in, or difference in, color of concrete construction; they impart to concrete a soggy, water-soaked appearance; they do not render it impervious to water for any great length of time; they do not decorate.

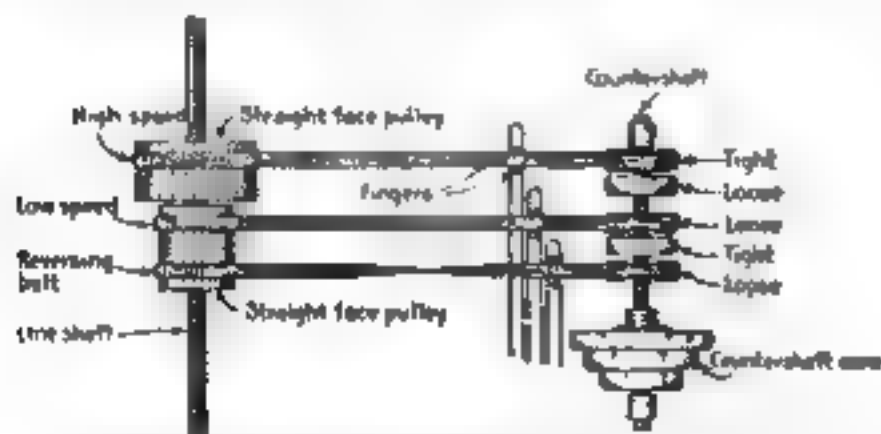
The following process for painting cement surfaces is favored by many expert painters. Slake a half-bushel of fresh stone lime in a barrel, and add in all 25 gal. of water; when cold, after slaking, add 6 gal. of pure cider vinegar and 5 lb. of the best dry Venetian red. Mix well and pass through a fine strainer. Thin to the consistency of thin cream. Apply a coat of this to the cement, and after a day or so, or when dry, apply a coat of red lead mixed in raw linseed oil. When the red lead paint has become dry any other colored paint may be applied, but care should

be taken to keep the red lead from working up into the paint above it, if the latter is a light color; hence the coat next to the red lead should be rather stout. Or you may make the second coat of paint with plaster of Paris and boiled linseed oil to the consistency of buttermilk, added to a batch of white lead paint made of the same consistency as the plaster paint; mix well together, and thin out to a brushing consistency with turpentine. This coat should be made as heavy as you can well brush it out. The next or finishing coat should be ordinary oil paint, drying with a gloss, the same as used on outside woodwork. The reason for applying the plaster paint is that it prevents the subsequent coats of paint from wrinkling or running where much paint is to be applied. It must be made to dry quickly, by means of dryers, so that you will not make the mistake of applying the succeeding coat prematurely, in which event there would be cracking of the paint. Observe particularly that no plaster is to be added to the last coat.

It should be said, in conclusion, that no oil paint is really waterproof, because linseed oil is not proof against moisture. This can readily be demonstrated by subjecting a dry coating of linseed oil paint to the action of water. Note how the coat whitens and swells, showing that the oil has taken up water.—A. ASHMUN KELLY.

Two-Speed and Reverse Countershaft for a Small Lathe

THE countershaft illustrated was devised and built for a small screw cutting lathe which was used for a great variety of work, from turning hard steel to high-speed wood turning, thus requiring

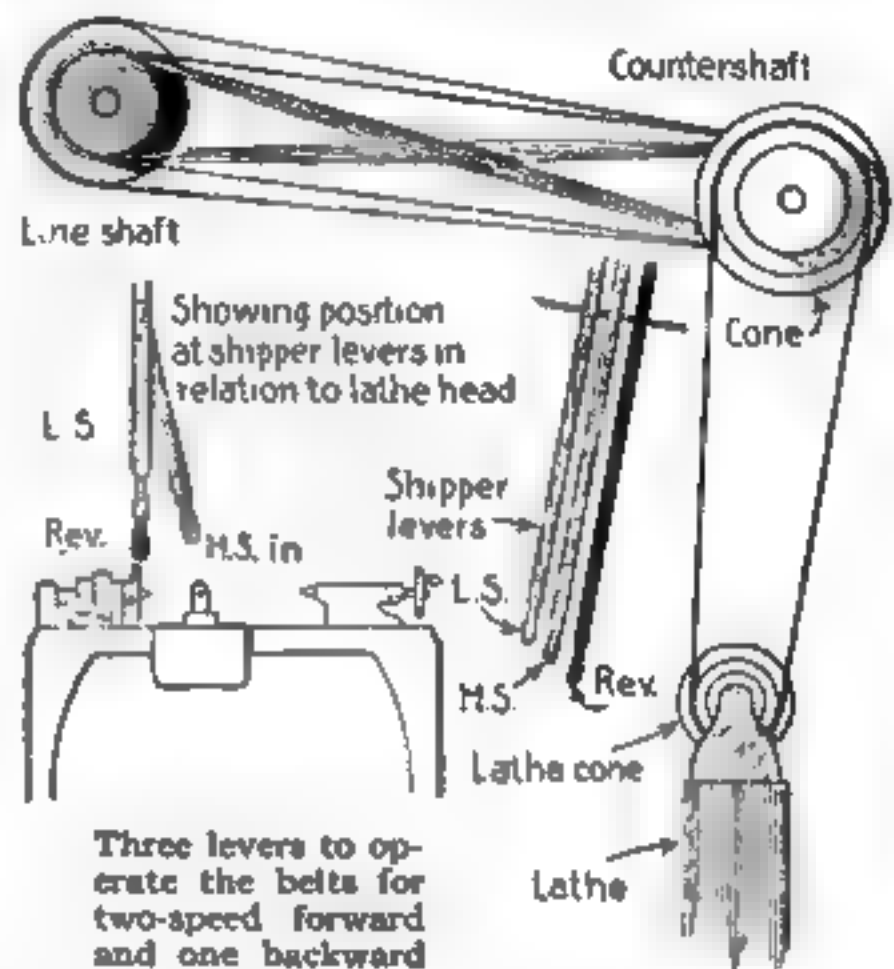


Pulleys of different diameters with three shipper levers to provide many different speeds

a wide range of speed. Two forward speeds and one reverse were provided, and as the lathe was furnished with back gears, the arrangement gave twelve speeds for normal

use and six for the reverse, the speed range running from 30 to 1000 r. p. m.

The three shipper levers were arranged conveniently near the head of the lathe, one behind the other, the low-speed lever



Three levers to operate the belts for two-speed forward and one backward

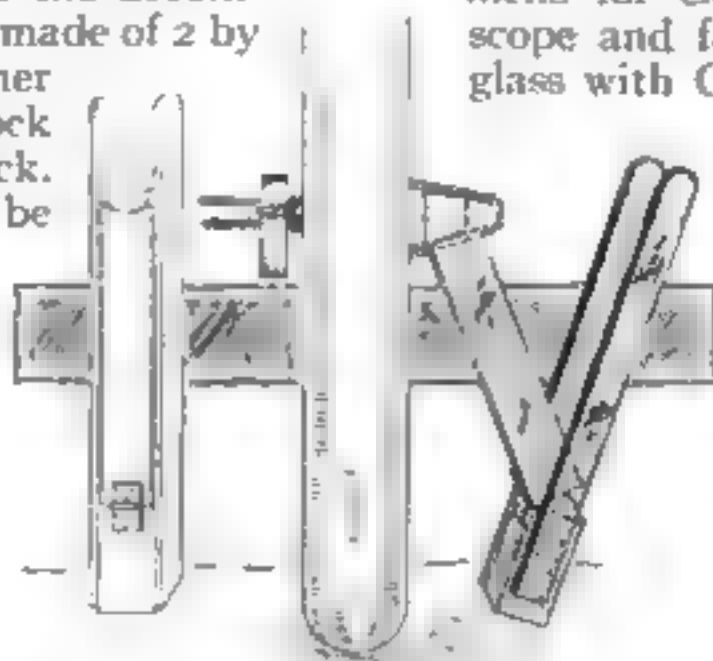
in front, next the high speed and then the reverse, which happened to be an iron lever. Had it not been of iron it would have been provided with a different shaped handle so that the operator would not be likely to throw it in by mistake. Tight and loose pulleys without friction clutches were used, those on the countershaft being of the same size, of iron, while the line shaft pulleys were of different diameters, and were of the straight face wooden type.—H. H. PARKER.

The Damage Caused by Running Tires Deflated

RUNNING a tire deflated for even a short distance is harmful to the tire and extravagant. When traveling at a very high rate of speed it may of course require some time to bring the car to a stop. But a certain amount of damage is done every second of deflation. A soft or flat tire on a front wheel can always be noticed by the difficulty in steering the car in a straight course—the steering wheel naturally veers toward the side of the flat or soft tire. If there is a deflated tire on the rear wheel, pounding and bumping will be noticeable. A rear tire ridden flat very far will result in damage to the differential.

A Jack to Keep Automobile Weight from Tires

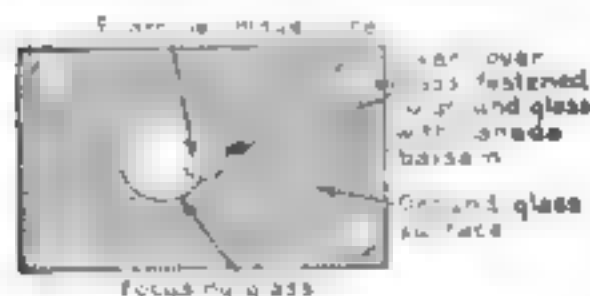
A SIMPLE jack for lifting the wheels of an automobile from the floor, to keep the weight from the tires while it is standing in the garage, is shown in the accompanying illustration. It is made of 2 by 5-in. material hinged together with strips of 1-in. stock fastened to the lower block. The lower block should be about 3 in. high and the second block should be long enough so that the combined length of the two will be about 1 in. longer than the distance from the underside of the hub to the floor. The method of hinging the blocks together and the manner of using them are clearly shown. It is necessary to build four of these, one for each wheel.—ABNER B. SHAW.



An individual wheel jack to keep automobile weight from the tires

Camera Focusing Screen for Fine Detail Work

WHEN the amateur photographer is confronted with the need of making a picture of an object in which the detail is very fine, he may find the ordinary focusing methods not sufficiently exact. At a slight expense, any camera with a ground glass focusing arrangement can be equipped with a superior focusing screen equaling those employed in high-class photo-micrography.



Microscopic focusing through the clear places in a screen

Take an unexposed plate having a single coated emulsion of the size used in the camera,

and expose it for one second in the dark room to a candle at a distance of 10 ft. Developing and fixing in the usual way will yield a plate with a slight tint of gray. The emulsion with its exceedingly fine particles of silver thrown down makes a focusing screen of much finer grain than the surface of the ground glass which comes with the camera. The class of work which calls for this kind of screen requires a

focusing glass to examine the image. The three-legged type with adjustable glass can be purchased at reasonable cost from almost any dealer, and is preferable.

Another way to do fine focusing is to get fine cover glasses used in mounting specimens for examination with a microscope and fasten them to the ground glass with Canada balsam. Since the balsam has the same index of refraction as glass, these fine spots will appear as clear glass. Now place the focusing glass partly over one of the cover glasses and focus on the surface of the ground glass, paying no attention to the image of the object to be photographed. Now focus the image on the screen, examining it not on the ground glass but in the clear space of the cover

glass. The image being examined is within the clear glass and is not distorted by irregularities of surface, however small. Such exact methods can yield proper results only when the sensitive plate at the time of exposure is in exact register with the image obtained on the screen.—C. E. DRAYER.

Lathe Centers Used as a Clamp for Gluing a Box

IN the absence of a clamp large enough to hold a box I desired to glue, I used the centers of my lathe as shown. The cone centers were removed and a faceplate used in both head and tailstock. The box was



The screw of the tailstock served the purpose of a carpenter's clamp for gluing the work

placed between these parts and the tailstock screw tightened. This held the parts firmly together while the glue dried. It is necessary that a box have its sides and ends perfectly square for gluing in such a clamp, as the face-plate surfaces are perfectly true and will press the parts together in a straight line.—JOSEPH PURDY.

Applying a Change-Speed Device to an Automobile Clutch

INVENTORS have made many efforts to provide a change-speed mechanism for automobiles in order to dispense with the unsatisfactory gears now universally used. A system, to be effective, should be so arranged as to avoid intermeshing gears. For availability of control the ratio of speed should be indefinite, the speed increased or decreased by the simple movement of a wheel or lever, and devoid of friction while in operation.

The hydraulic system has been exploited in various ways, but the devices, as heretofore constructed, showed certain disadvantages, namely: the liability of the expansion of the oil to such an extent as to injure the device or greatly lessen its efficiency; the inability to make the device small enough for easy installation; the great weight involved; the necessity for using both pumps and motors, and the slip due to leakage past the working parts.

The foregoing objections appear to be overcome by a new development of the hydraulic drive, which utilizes the clutch as one element in the change-speed mechanism. The entire device occupies but a little more space than the male part of the standard clutch, which it displaces, as no clutch is necessary in using a car with this invention.

The drawings give a comprehensive view of the device, as all of the elements are shown in the two views. The body of the device is a cylindrical shell, the perimeter of which fits the standard clutch element inside of the fly-wheel. This is held in place either by friction or by means of cap-screws, so that it is permanently fixed to the wheel.

The rear side of the shell has a removable plate, the mechanism for changing the speed being secured to the inner surface of the plate, while the reversing mechanism is on the outside of the plate.

Within the shell are four radially-disposed cylinders, each cylinder having within it a piston, suitably packed with rings, following the usual practice. The

stub-shaft, which enters the rear plate of the shell, has a single crank to which the four connecting rods are secured, so that the pistons have a successive motion to and fro as the shell turns, provided, of course, that the oil is confined in the pistons.

The head, or outer end of each cylinder, has ports on two opposite sides, the outer surface of each cylinder, along the ports, being planed flat and covered by slide valves which move axially, or parallel with the stub-shaft. The valves are L-shaped and provided with suitable openings to co-ordinate with the ports of the cylinders, each valve being

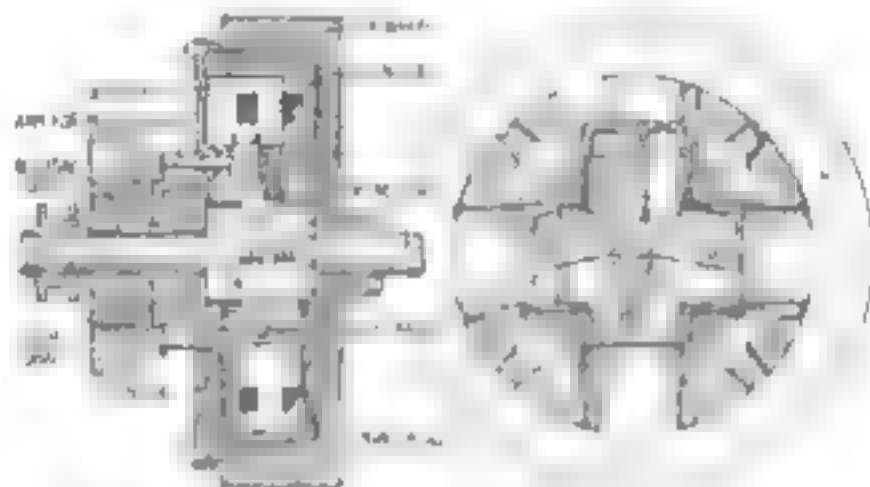
designed to open or close the ports of two adjoining cylinders. To effect this, each L-valve has a stem which passes through the removable plate of the shell, the outer ends of these stems being rigidly attached to a rim which, although it turns with the shell, is, nevertheless, easily adapted to connect with an operating lever.

less, easily adapted to connect with an operating lever.

It is obvious that, as the cylinders are rigidly attached to the shell, the stub-shaft will not turn if oil is permitted to freely pass in and out of the cylinders. The only effect in such a case would be to produce a reciprocating motion of the pistons. When, however, the driver of the car moves forward the lever which causes the L-valves to travel inwardly, and the ports of the cylinders are closed thereby, the pistons are restricted in their reciprocal motions, and the shaft turns, the rate of speed, relative to the engine speed, being dependent on the quantity of oil which is displaced at each revolution. If the ports are entirely closed, then the stub-shaft will travel at the same rate of speed as the engine-shaft.

It will thus be seen that there is no appreciable loss of power, and the slight amount of oil which escapes past the valves imparts a resiliency, or flexibility, to the car comparable to the electric or magnetic drive. There is not a single gear in the entire mechanism for driving the car forward.

For reversing, however, a train of gears is employed; or conical friction wheels may be used. A small bevel gear is fixed to the



The speed is changed by air pressure applied to the four cylinders used instead of the clutch

removable plate, so that the stub-shaft turns therein freely. A similar gear is mounted on the stub-shaft so that it also revolves thereon. A pair of bevel gears between the aforementioned loose gears, are mounted on spindles attached to the journal-bearing plate, which cause the loose gear on the stub-shaft to travel in a direction opposite to the cylindrical shell.

The fork which is connected with the usual clutch-pedal is used in this device for reversing purposes. The fork engages with a grooved chuck which has radially-disposed tongues, designed to engage with suitable radial grooves in the hub of the loose gear. As the grooved chuck turns with the stub-shaft, although free to move to and fro a limited distance, it can be thrown readily into engagement with the gear, and thus be turned by the stub-shaft in a direction opposite to the fly-wheel or engine-shaft.

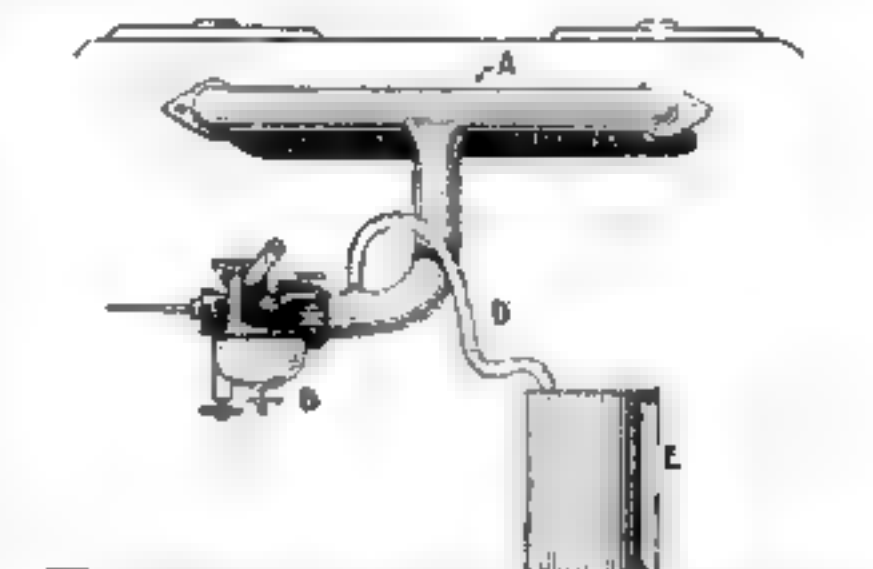
Several features of interest may be noted in this device. The pump itself is also the motor, thus eliminating at least one half of the elements usually employed. The double pressure used with the pump and motor systems, is avoided, hence less heat is generated. Aside from this, the oil merely flows in and out of the cylinders, and the friction of movement through long and tortuous ducts is avoided, thereby greatly increasing the efficiency of the device.

One of the most important advances, however, is in the provision for taking care of the oil expansion. In hydraulic systems the cases containing the mechanism must be entirely filled with oil, or with the liquid used to provide the transmission. In this invention the pistons are just as effective if the shell is half filled, for the reason that the ports are at the outer ends of the cylinders, and as the shell revolves the oil is thrown outwardly by centrifugal force so that the ports are always submerged with oil and are capable of taking a full charge without drawing in air.

Fully half of the cubical contents of the shell may be devoted to air, or a partial vacuum may be formed therein, thus taking care of any undue expansion. It has been found that a large part of the heat developed and maintained in the hydraulic systems was due to the expansive force exerted on the oil itself, so that large chambers were necessary for this purpose. In a system using two gallons of oil, the expansion of the oil has frequently measured over two quarts.

Softening Carbon with Steam in the Automobile Engine

THE greatest enemy to the free running of an automobile is the carbon which collects in the cylinders of the engine. The



Injecting water in a small spray into a gasoline engine to soften and partly remove the carbon

carbon may be softened and to a certain extent removed by running water through the cylinders with the gasoline. If a small rubber tube *D* is attached over the air-cock on the manifold *A* and run into a pail *E* of water set at about the level of the carbureter *B*, the engine, when running, will suck in the water and then discharge it as steam with the exhaust. After the tube has been removed the engine should be run for a few minutes to make sure that no water remains in the carbureter.

If this is done every thousand miles the car will run much easier. A more thorough job may be done by removing the cylinder head and scraping the carbon away. After the steaming the carbon will be found soft so that most of it can be wiped away with a cloth. The rest is easily scraped off.—WILLIAM H. LEACH.

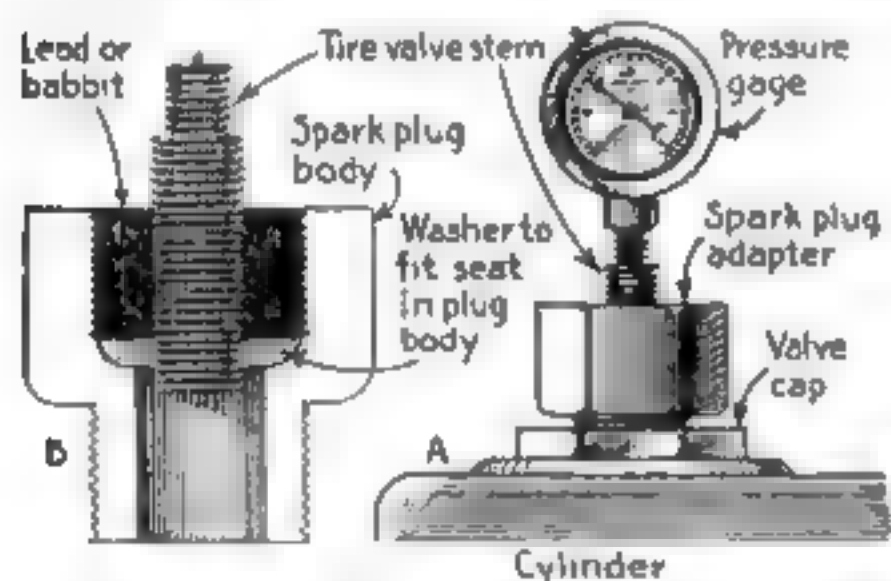
An Easy Method of Testing Gasoline Engine Compression

AN important factor having material bearing upon the power output of the automobile engine is the amount of compression of the gas in the cylinders prior to ignition. If one cylinder has less compression than the others, the engine will not pull smoothly under load, as the cylinders having the highest compression will have more power. An easy method of testing gas compression is outlined in the accompanying illustration. An ordinary tire pressure gage either of the dial pattern or the plunger type may be used instead of the

more accurate and expensive special pressure gage. The tire gages will register correctly in most cases, or at least will show closely the amount of pressure so that it may be compared in the different cylinders.

An adapter fitting is necessary for use with a tire gage, and may be made without difficulty from cast-off parts found in any garage. A discarded spark-plug body forms the main portion of the adapter as shown at *A*. The inner tube valve-stem is provided with a thread along its entire length for the check-nut used to keep it in place on the tube. A special washer of brass is filed out to fit the seat in the spark-plug body, against which the porcelain is clamped and the valve threaded into place. Of course, if the washer at the bottom of the valve-stem that fits inside the inner tube is large enough, this may be used. Otherwise, the valve-stem should be cut off and screwed into the special seat washer.

The parts are assembled as shown at *A* and held together by pouring molten lead or babbitt around the valve-stem. When the filling material cools, a tight joint is assured because the metal fills the threads in the spark-plug body and valve-stem. To use, the adapter-fitting is screwed into the spark-plug hole as shown at *B*. The engine may be cranked by the self-starter or turned by hand and the tire gage will show



A tire gage fitted in a discarded spark plug body to test the compression of a cylinder

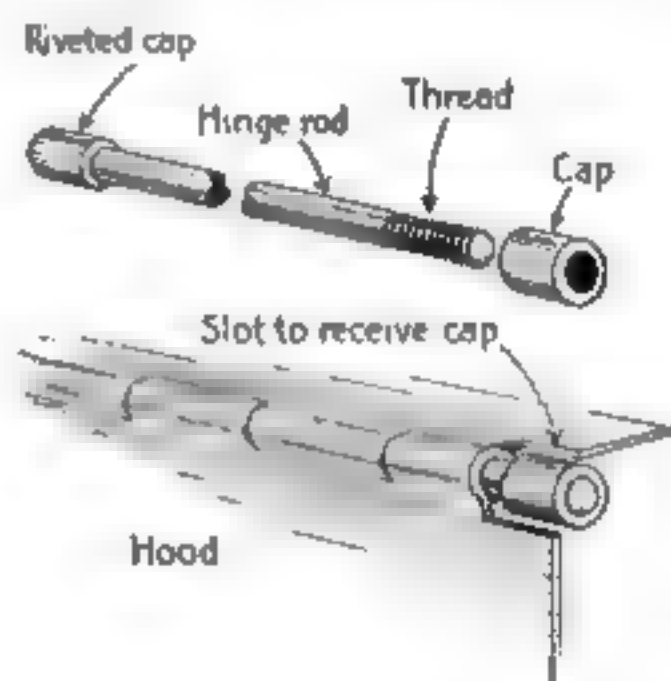
the compression in pounds per square inch existing in the cylinder interior if it is held in such a way as to depress the valve inside. A comparison may be made between cylinders by testing each in turn.

If the compression is weak, there is an opportunity for gas leakage somewhere, usually around the piston rings or through the valves. The average compression in a gasoline engine when cold is 75 lb. Some

engines have less, others more. Compression is determined by the volume of the engine combustion chamber as compared with the total cylinder contents. High compression engines are more apt to knock when carbonized than the low pressure engines.—VICTOR W. PAGÉ.

Preventing Hinge Rods from Loosening on an Automobile Hood

ON most low priced cars there is no provision made to hold the hood hinge rods in position, and they invariably be-



A round nut turned on the end of the hinge rod keeps an automobile hood from rattling

come loose, due to the vibration. The illustration shows a method of eliminating this trouble. It is only necessary to provide two end caps for the rods, one of which is fastened permanently while the other is free to be removed by using threads. It is also necessary to remove a portion of the hood to provide suitable clearance for the caps. The rods in their new form are held securely in position.—ADOLPH KLEIN.

The Proper Camber for the Front Automobile Wheels

THERE is no specific standard for the camber or canting of front wheels outward at the top, but it is done on most of the cars, to make it easier to steer and turn the curves than would be possible if the wheels were perpendicular. This camber of the front wheels of different cars varies from $\frac{1}{4}$ in. to $1\frac{1}{8}$ in. between inside felloe measurements. If the wheels stand too far outward at the top, there is apt to be some binding effect at the axles, and the tires will not roll freely.

Making a Re-Winder for a Motion Picture Film

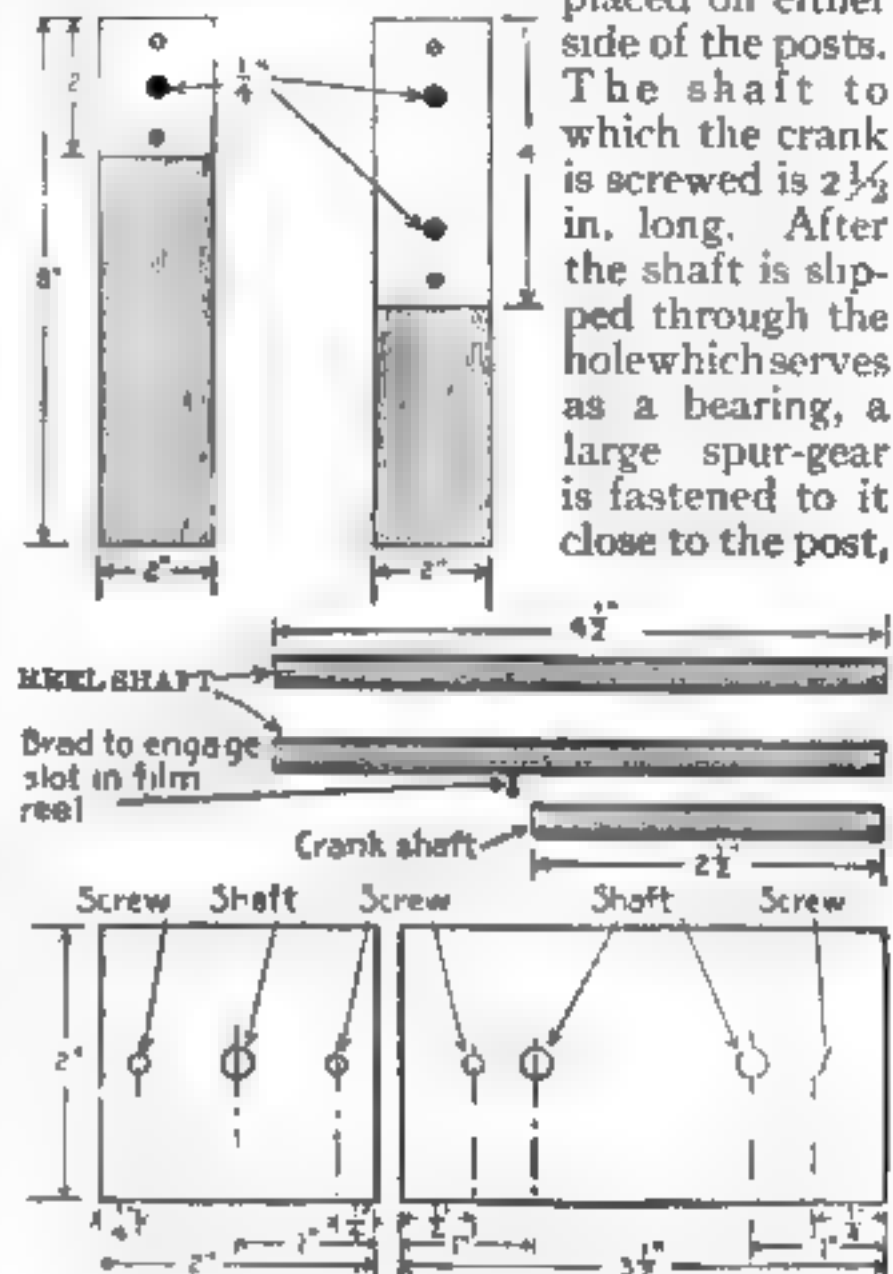
AFTER a motion picture film has been run through a projecting machine it is necessary to re-wind it upon another reel before it can be exhibited again. There are many devices on the market for doing this. For the amateur possessing a small machine and not wishing to purchase a re-winder, the device described herewith will be found adequate.

The re-winder consists simply of two supports fitted with suitable shafts for the film reels to revolve upon, one of which is provided with a crank and ratio of gearing, to enable the speedy re-winding of films. The one described in this article is intended for the standard 1000-foot reels, which are about 10 in. in diameter, but the dimensions may be varied to accommodate larger reels, if desired.

The supports are two posts, preferably of hard wood, 8 in. long and 2 in. square. At a point 1 in. from the top of each post a $\frac{1}{4}$ -in. hole is bored through the center. From $\frac{1}{16}$ -in. sheet steel four plates are cut, two of them 2 in. square, and two $3\frac{1}{2}$ by 2 in. The two smaller plates are drilled as shown in the drawing with three $\frac{1}{4}$ -in. holes, and screwed to the sides of one of the posts so that the central hole coincides with the hole in the post. This forms the bearing for the shaft which supports the reel. The two larger plates are drilled with four holes, and screwed to opposite sides of the other post so that the two central holes coincide with the two

projecting. This is to fit into the corresponding slot in the reel so that it will revolve with the shaft. The shafts are slipped into their bearings in the posts and held in place with collars and set screws

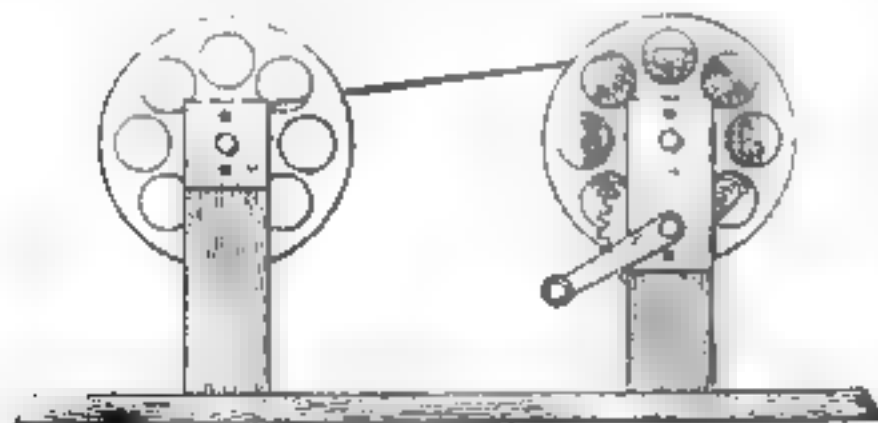
placed on either side of the posts. The shaft to which the crank is screwed is $2\frac{1}{2}$ in. long. After the shaft is slipped through the hole which serves as a bearing, a large spur-gear is fastened to it close to the post,



Dimensions of the parts, plates and shafts for making a convenient re-winder for films

meshing with a smaller gear on the reel shaft. These gears may be of any convenient size, but a good ratio is three to one, the smaller gear being $\frac{3}{4}$ in. in diameter, and the larger one $2\frac{1}{4}$ in.

The two supports now completed are screwed to a base consisting of a board 24 in. long, 6 in. wide and $\frac{1}{2}$ in. thick. To allow an inspection of the film as it passes from one reel to the other, these should be placed about 20 in. apart. When it is desired to re-wind a reel of film, the collars on the protruding ends of the shafts are removed, the reels slipped in place, and the collars replaced.—LUCIUS E. WINCHESTER.



A film must be reeled back before it can be run through the projecting lantern again

holes in the post. The reel supports are now completed

The shafts on which the film reels revolve are $4\frac{1}{2}$ in. long and are cut from $\frac{1}{4}$ -in. brass tubing: At a point $1\frac{3}{4}$ in. from the end of one of these rods a $\frac{1}{16}$ -in. hole is drilled and a small brad driven into it and filed off, leaving a point about $\frac{3}{16}$ in. long

A Hard Finish for a Lunch Counter Top

THE best finish for a bar or lunch counter is linseed oil well rubbed into the wood when it is new, and often later on.

A Storage House for Potatoes

Use of pits, dugouts and masonry houses for the storage of potatoes as discussed by the U. S. Department of Agriculture

POTATOES of the main crop can be stored satisfactorily throughout most of the United States in the dugout pit or potato cellar in some of its various forms of construction. No attempt should be made to store potatoes of the early crop, as they are usually sold for immediate consumption.

While the dugout storage house is in most general use, concrete or masonry houses with frame superstructures are, perhaps, most satisfactory in cold climates. In some sections, especially in the South where drainage is poor, insulated frame structures built entirely above the ground must be depended upon.

The primary purposes of storage are to protect the tubers from extremes of heat and cold and from light. Account also must be taken of conditions of humidity and ventilation and of the size of the storage pile.

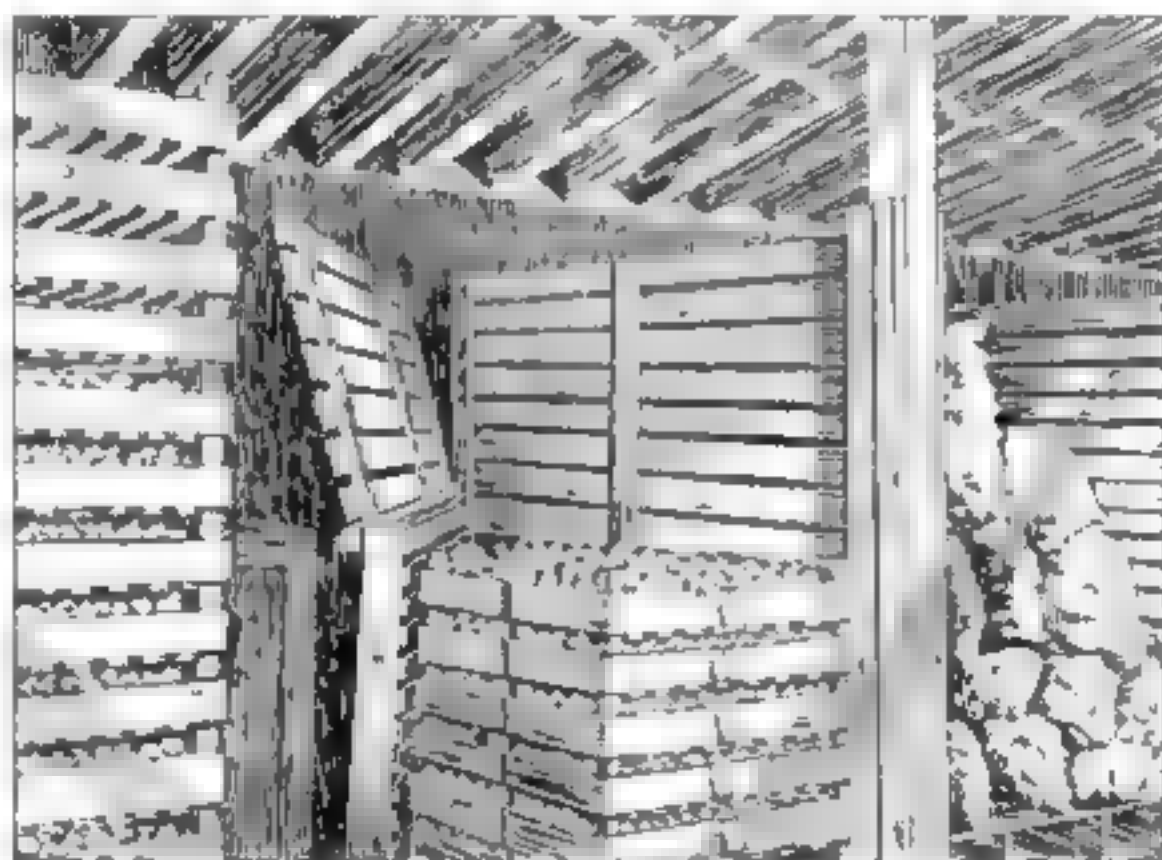
The temperature should be the highest at which potatoes will remain firm and ungerminated, and which will at the same time hold fungus diseases in check. Experiments with artificially refrigerated storage indicate that 36 deg. F. is sufficiently low for all practical purposes and that during the earlier portion of the storage season a temperature of 40 deg. F. is just as satisfactory as a lower one except where powdery dry rot infection occurs.

All natural light should be excluded from potato storage houses, because when the tubers are exposed to even modified light, they are soon injured for food pur-

poses. A practical rule in regard to humidity is to maintain sufficient moisture in the air to prevent the wilting of the tubers and at the same time to keep the humidity content low enough to prevent the deposit of moisture on the surface of the tubers.

If too many potatoes are put in one pile they may become overheated and may deteriorate. About 6 ft. is a good maximum depth for piling tubers in bins, and the

area covered by each pile also should be limited. A good plan is to insert ventilated division walls at intervals through the pile or bin. These may be made by nailing relatively narrow boards on both sides of 2 by 4-in. uprights, 1-in. spaces being left between the boards. General ventilation for



Potatoes should not be piled too deep in a bin. It is better to use trays or ventilators placed conveniently

the whole storage house usually is accomplished through ventilating shafts in the roof.

The two best methods are the most expensive; masonry or concrete houses, and artificially refrigerated storage houses. Pitting is the most primitive way, but if properly done in well-drained locations it is satisfactory in so far as the preservation of the potatoes is concerned. The chief drawback to pitting is that the potatoes are not always easily accessible in the winter.

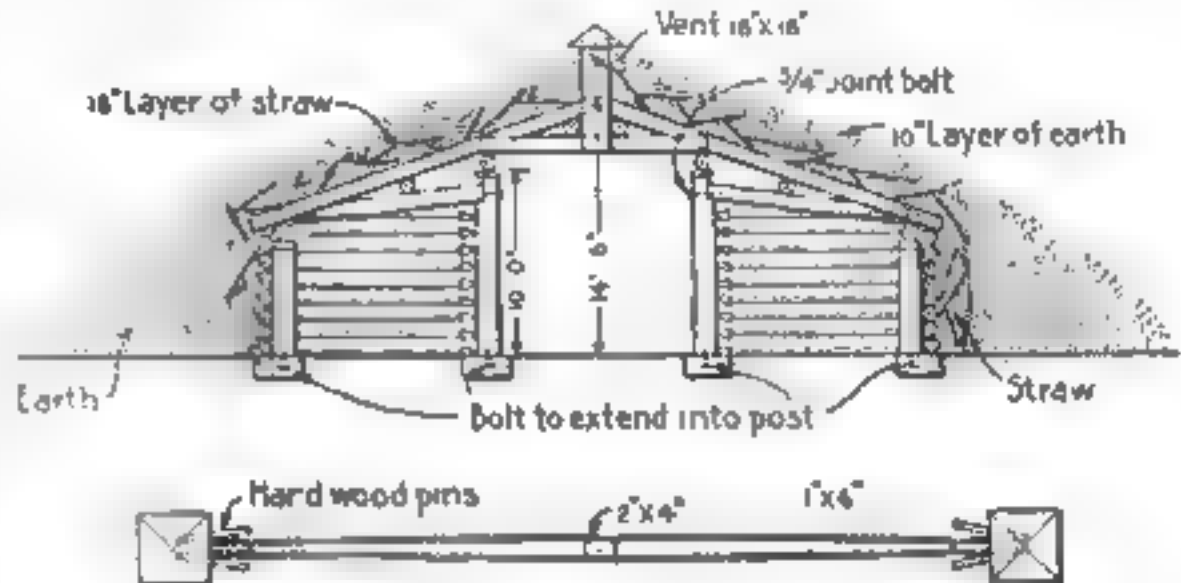
The dugout pit or potato storage cellar is probably more widely used than any other type of storage space. Fitted with a water-tight roof it is especially popular in the central portion of the United States. In the arid and semi-arid sections a type

with sod or dirt roof is in most general use. As a rule, the excavation for the cheaper structures of the dugout pit or cellar type when erected on a level or nearly level land does not exceed 3 ft. The soil removed from such an excavation, particularly if the dugout is of considerable size, is ample for banking the side and end walls and also for the roof. The cost of construction may be greatly modified according to the character of the location.

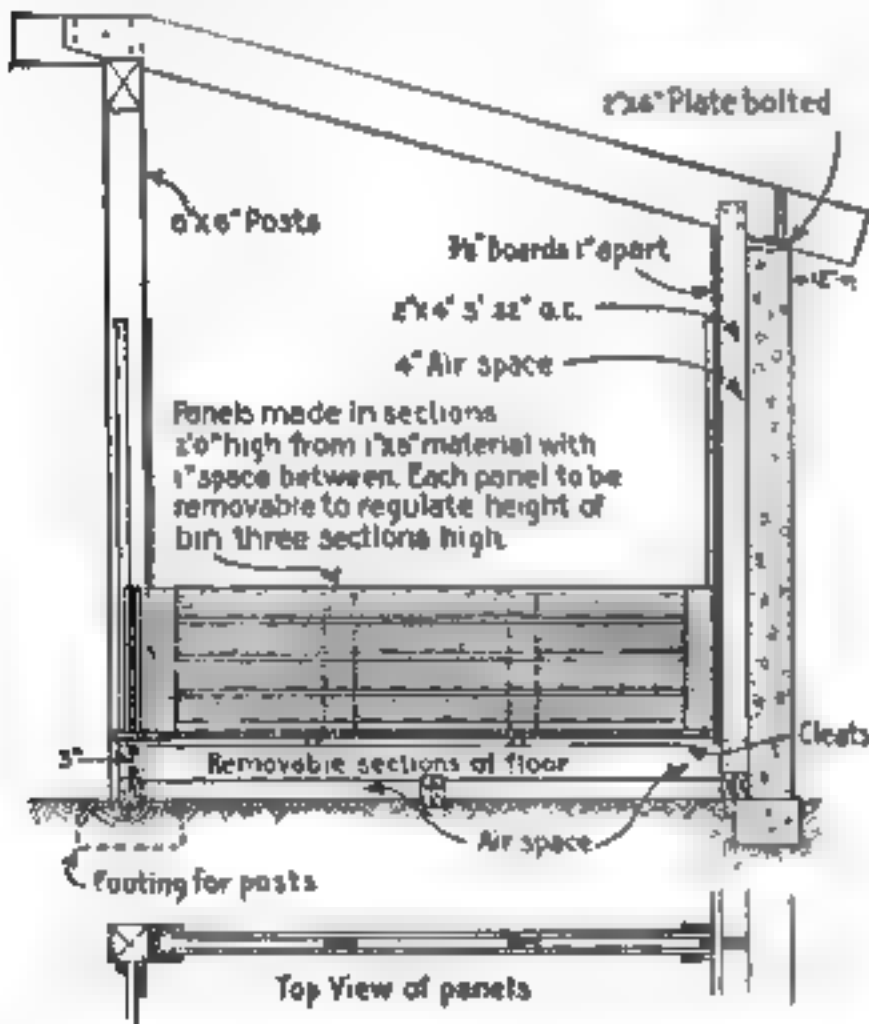
In the cheaper dugouts, where the soil is of such a nature as to remain intact, it is allowed to form the side and end walls, the roof being supported on plates resting on the soil and held together by boards or joists. This form of construction involves a deeper excavation and a constant element of risk from a cave-in. In the more expensive and substantial structures the side and end walls are built of concrete.

Insulated frame potato storage houses are not used very extensively. As a rule they are better adapted to southern than to

house is not to be recommended for northern locations, nor is it advocated for the South except where poor drainage conditions will not permit the use of the dugout



A cross-section of an end elevation of a potato storage cellar successfully used on a western ranch



Section of a potato storage cellar showing method of constructing the aerated bin

northern climatic conditions. The construction feature of such houses is the thorough insulation of their walls, ceiling, doors and windows. This type of storage

or cellar style of house for the purpose.

While it appears that the dugout is more or less familiar, a general description of one will be considered. Generally speaking, the potato cellar should be located in a spot convenient to the dwelling house, because in very cold weather it requires rather close attention to guard against the frost. Where side hills, or knolls, are available it is advisable to take advantage of them, because, as a rule, by their use better drainage and ground level entrance at either one or both ends of the house are secured. Where these conditions are not available and a central driveway is planned, an inclined drive, which should be carried back far enough to permit easy approach, is necessary. Where no wagon entrance is contemplated, provision is usually made for placing the potatoes in the cellar through an opening in the roof, in which chutes are inserted to convey the tubers. In this type of storage house a bulkhead entrance is provided in order to permit easy access for the removal of the stored crop.

Occasionally, where the land is level and there is danger from irrigation seepage, the storage house is built entirely above the ground. In this case, while the construction of the side and end walls and the roof is practically the same as the preceding, the cost is usually increased on account of the greater quantity of soil required to cover the roof and the side and end walls.

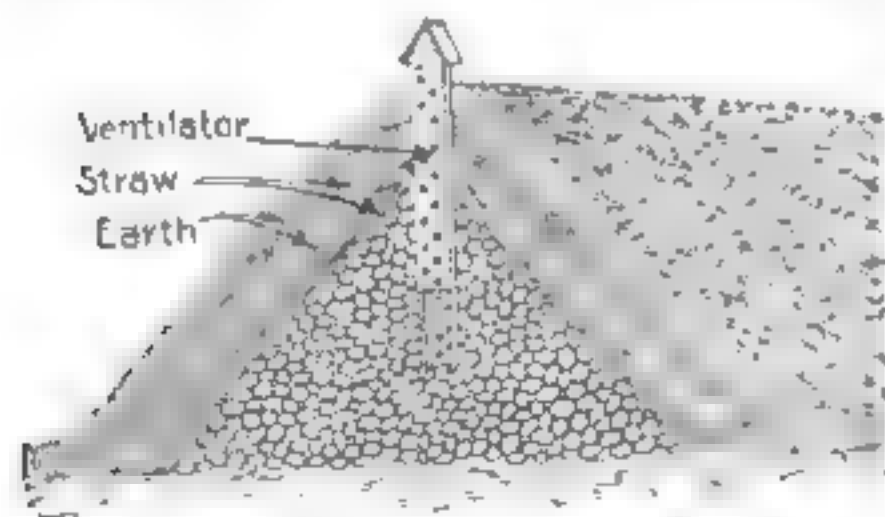
Where a tough sod is available, such as that formed by flags or other wiry rooted plants, the side and end walls above the

ground may be constructed entirely of blocks of sod 2 ft. or more in thickness. One of the most unusual storage houses seen in the course of these studies was built entirely above the ground with the side and end walls constructed of bales of alfalfa hay.

In the more expensive and substantial structures the side and end walls are built of concrete. The roof of the dugout, or cellar storage house, in the region under discussion is generally of unsawn lumber. Usually the rafters are cut from small trees. The whole roof may be covered with poles and these poles covered with straw and soil, or the rafters may be covered with heavy woven-wire fence netting and then with straw and soil.

In sections where rainfall is sufficiently heavy to render a straw or pole-covered roof undesirable, the potato storage cellar is constructed with a water-tight roof. Generally, the roof is covered with rough lumber and shingled. Occasionally a cellar is sheathed with matched lumber on the inside. This treatment provides a fairly well insulated roof, which requires but little further protection except in protracted spells of cold weather, when a layer of straw or strawy manure is advisable.

The water-tight roof type of the western potato cellar is admirably adapted to storage in the northwestern and middle-western United States wherever good drainage can be secured. Furthermore



Cross-section of a potato pit with layers of straw and earth and a perforated ventilator

it is one of the most economical types of natural storage.

A ventilator should be so constructed that the opening at the top is protected by a cap, which may be rigid or hinged. It should extend through the roof and into the cellar far enough to permit a swivel damper to be inserted and operated by a

spring or lever, or else a slide damper which can be opened and closed at will. The ventilator should be of sufficient size to admit a reasonable volume of cool air and facilitate the egress of warm air.

While the total exclusion of light is an



An insulated frame potato storage house used for storing the second crop of potatoes

essential feature of the construction of a good potato storage house, it is necessary to have some light where workmen are engaged in sorting and preparing stock for the market or for seed purposes during the winter. Usually no provision is made for lighting the storage house by natural light except that which may filter through the ventilator shafts when lifting the ventilator caps, or which may be obtained by opening the doors. This method of admitting light can be employed in winter only during mild weather. Light is admitted in some storage houses by inserting a movable window glass or hinged window in the ventilator shaft. Such an arrangement permits the removing of the ventilator cap in severe weather without endangering the stored potatoes by lowering the temperature below the safety point. But this does not provide a wholly satisfactory lighting system, and reliance must still be placed in a lantern or lamp.

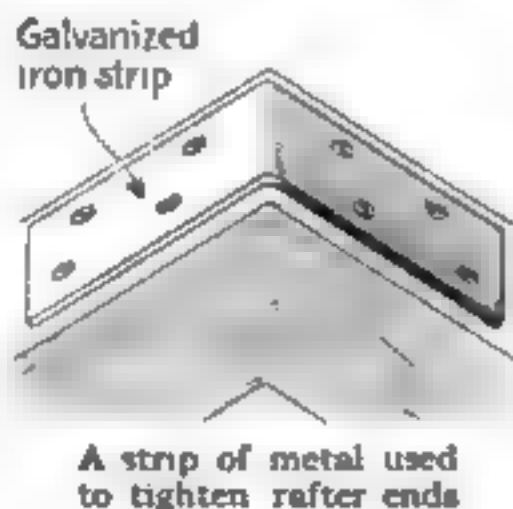
A Paste Lubricant for Starting Screws and Nails

BEESWAX and tallow melted together and put into a box or mold make a very good lubricant for starting nails and screws. Owing to the nature of the materials, this paste also prevents rust.—JAMES M. KANE.

To Keep the Ends of Rafters from Spreading

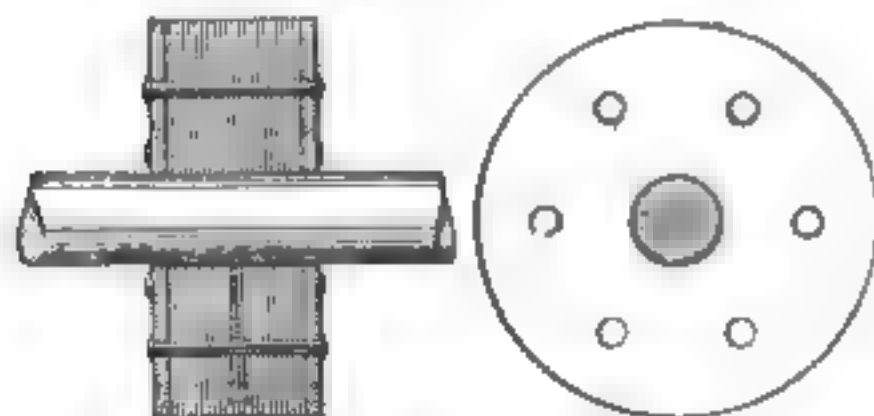
IT frequently happens that ridge boards show a tendency to spread at the mitered joint. When they do, it is usually difficult to draw them and keep them together with nails. Even if they have been drawn together they may spread later under changed atmospheric conditions.

A simple, un-failing and permanent way to cure this defect is to take a strip of galvanized sheet iron $1\frac{1}{2}$ or 2 in. wide and from 18 in. to 2 ft. long, depending on the size of the ridge boards, and nail it over the top of the joint as shown in the sketch. Care should be taken to make it fit tight. This can be accomplished by nailing one side fast, then bending and hammering the other end down and pulling it by skewing some of the nails. It will be found that the boards can be drawn together tighter this way than by merely spiking them together.



Making a Substantial Cardboard Pulley for Belts

TURN two metal washers of the required diameter, having the center hole a tight fit on the shaft. Cut out enough cardboard disks to make the pulley of the required width. Soak these disks in hot beeswax and place them on the



A number of cardboard disks clamped between metal washers to make a pulley

shaft between the two washers. After carefully squaring them with the shaft, clamp them tightly together with three screw-clamps. Between the clamps drill three rivet holes. Rivet together as tightly

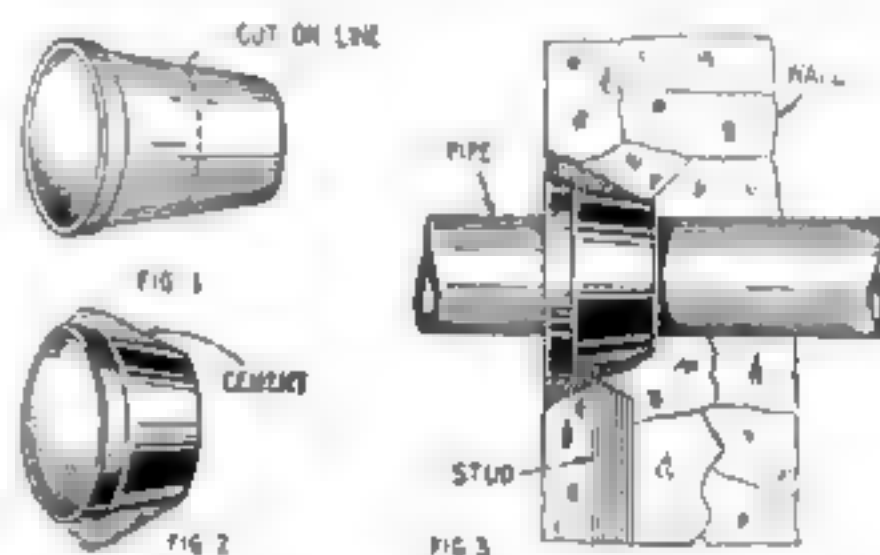
as possible, leaving the clamps in place until all three rivets are in. After removing the clamps place three more rivets between the first three. The set-screw is made by screwing a wood-screw into a previously drilled hole.

While the beeswax is not absolutely necessary it aids greatly in solidifying the pulley and affords an excellent grip to the belt.—FRANK L. MATTER.

An Insulator and Fire Protector for a Stovepipe

RECENTLY when cutting through a stone wall preparatory to running a stovepipe, I found the pipe would be too close to a wood stud. Being without the proper chimney-pot, I made one from a small flower pot.

I first made a saw cut all the way around, as in Fig. 1, then smeared the edge with cement, as in Fig. 2, and placed it in



A flower pot used to make an insulator for a stovepipe passing through a wall

the opening as in Fig. 3. To cut a pot like this it is better to use a grindstone instead of a saw. There is much less chance of the pot breaking.—JAMES M. KANE

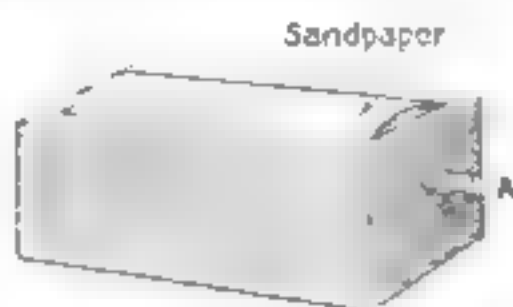
A Solution for Electro-Plating with Aluminum

DISSOLVE any desired quantity of an aluminum salt, such as the sulphate, acetate, or nitrate, in distilled water and concentrate these solutions to twenty Baumé in a suitable vessel to hold the articles to be plated.

The battery to be used should be three pairs of Bunsen cells with the wires coupled up for intensity and an anode of aluminum attached to the negative wires. The solution should be slightly acidulated with its approximate acid heated to 140 deg. F. and kept at that temperature during the operation.—HERMAN NEUHAUS.

A Lead Pencil Sharpener with Dust Collector Box

THE pointer consists of a box in which a wood cylinder is placed having a diameter almost the same as the box opening is wide. This roller is hung on a shaft, one end of which extends out for a thumb hold. Sandpaper is tacked to the surface of the roller. After pointing the pencil the roller is turned to deposit the dust in the box.—G. P. LEHMANN



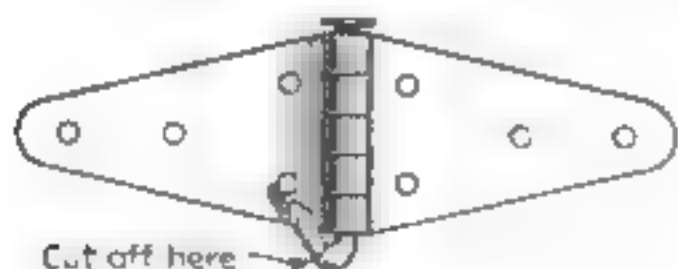
Sandpaper covered roller for pencil sharpener

A Stain for Giving Wood a Brilliant Rose Color

WOOD and vegetable ivory can be colored rose-red without much difficulty by chemical precipitation. The color resulting from the following baths is very brilliant and uniform. The first bath consists of a solution of eight parts of potassium iodide added to a hundred parts of water; the second, two and a half parts of corrosive sublimate to a hundred parts of water. The wood is immersed for a few hours in the first bath, then placed in the second bath, where it acquires a beautiful rose-red color. After drying, it should be varnished. Both baths can be used repeatedly before renewing them.—HERMAN NEUBAUS.

Repairing a Fast-Pin Hinge Where Riveting Is Impossible

SOME time ago, having lost the key to my toolbox, I had to file off and withdraw the pins of the hinges to open the box. The hinges themselves were all



An ordinary wire nail sharply bent and used for a hinge pin

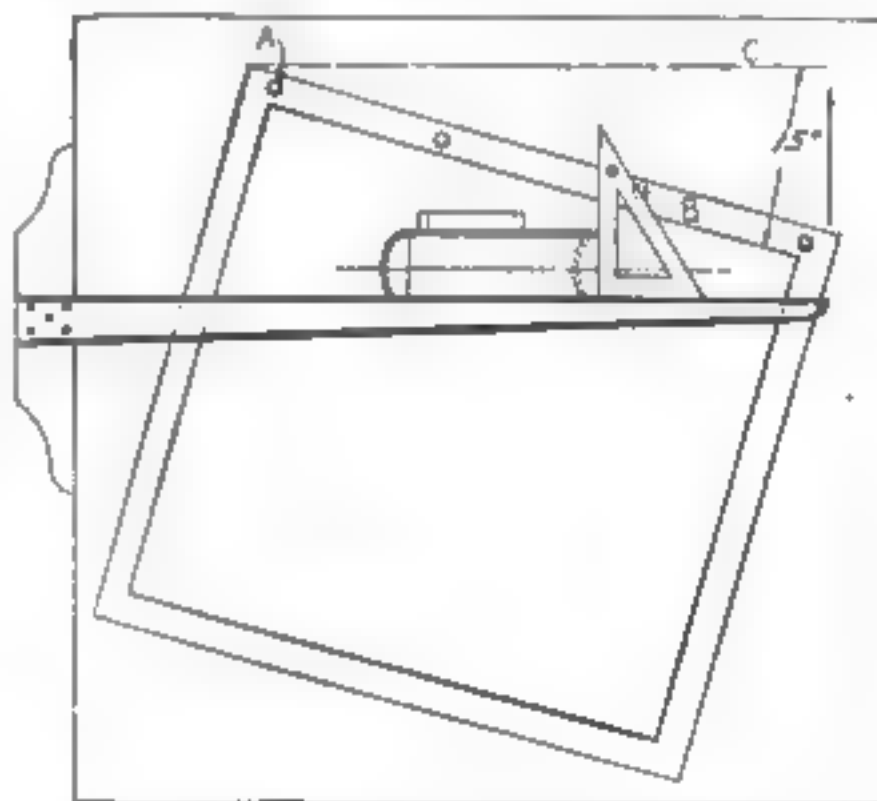
riveted on. When I attempted to replace the pins I found it impossible to rivet them, because I could not hit them hard enough to form the rivet.

I used the box with loose pins until an easy solution occurred to me. This was to take long spikes, slip them through the hinges as far as they would go, and bend them sharply with strong pliers, as shown in the illustration, after which they were cut off half-way on the bend.

This same method can with advantage be used in cases where it is desired to change a loose-pin butt into a fast-pin one, and where riveting is impracticable.

Drawing Perspective Views by Moving Paper on Board

IN the illustration is shown a method of drawing perspective views of machinery, buildings and the like. Instead of using a protractor it is only necessary to remove all the thumb tacks except the one shown at A, which is used as a fulcrum. When the sheet of paper is moved to the desired



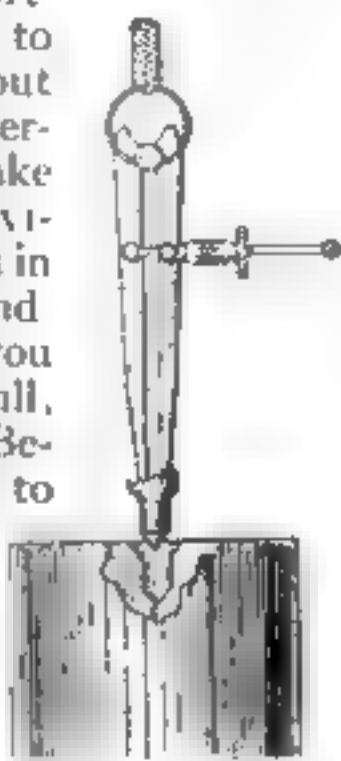
Swing drawing paper on board to get the proper perspective lines with T-square

angle of projection, proceed with the T-square and the triangles just as for plain horizontal and vertical lines. After the paper is set to the required angle the thumb tacks are replaced.

While the paper is still set square with the drawing-board, the border lines should be drawn. The one marked B is used in connection with another marked C on the board for setting the paper, or a protractor may be used direct, if there is one at hand. The general layout should be penciled first. An angle of about 15 or 20 deg. is the greatest that is practicable with this method.—J. B. MURPHY.

Removing the Point of a Broken Center Drill

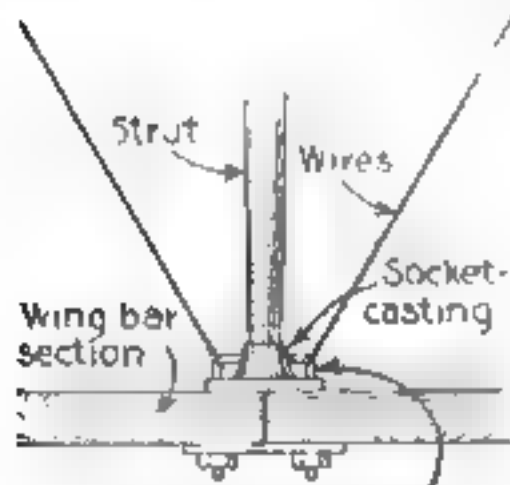
WHEN centering shafts to be turned in a lathe it often happens that the center drill breaks off short. It is then very difficult to take out in most cases, but the following method overcomes the difficulty. Take a small pair of spring dividers and insert the points in the flutes of the drill end. Tighten the nut until you have a firm hold on the drill, then simply pull it out. Before making the attempt to draw out the broken part it is quite necessary to see that the drill cutters are not stuck in the metal as some damage might result to the dividers if they should slip off when making the pull.—ALFRED W. MARDT.



Pulling out a broken center drill point

A Safe Method of Joining Airplane Sections or Wings

JOINING together airplane sections or wings is not a matter to be lightly regarded, when you consider the danger to the aviator if a brace wire should break during the flight.



U-bolt holding strut, socket and wings in one rigid unit.

A U-bolt placed at the joint of three pieces

The ordinary method at present in use is not absolutely reliable; for, should a brace wire break, the strut holding the top and bottom planes in position may pull out of its socket and cause the airplane to become uncontrollable. A sure

and safe way to overcome this danger is clearly shown in the illustration.

A U-bolt is used, each leg passing through the ends of the horizontal pieces and through the vertical strut and socket, connecting the wing bars, socket and strut all in one unit. Eyebolts, as used in the present methods, will not hold the strut

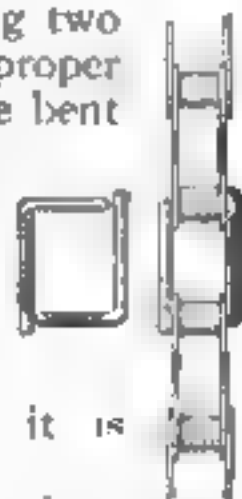
should a wire break. The U-bolt construction will not only hold the strut in position should a brace wire break during the flight, but it will also serve as wire terminals for the brace wires.—WM. GROTZINGER.

A Closet Rod Which Will Accommodate Several Suit Hangers

A ROD or pipe fastened lengthwise in your clothes closet will be found a convenience. You can hook over it several clothes hangers in such a way that the clothes will not touch and can be slid back and forth. Any narrow pipe will do, or a fine self-made attachment will be found in the "robe rails" sold to auto owners for fastening in the car tonneau.—CLARENCE F. HUBBARD.

Repairing a Broken Link in a Motorcycle Roller Chain

A NOVEL yet very practical way of making an emergency repair on a motorcycle chain is illustrated. This link is easily made by bending two cotter pins of sufficient length and proper size to the shape shown. The bent end of the cotter is run through the chain parts, allowing the longer end with the eye for the side plate. As will be seen, the split end of the cotter enters the eye of the opposite one, where it is clinched.



These pins are not hard enough to make a permanent repair, but they will help a rider out in a pinch and can be used until a more lasting link can be put in the chain.—J. R. SCHULTZ

Etching Photographs on the Surface of Glass

THE following is a simple method of etching photographs on glass:

Cover the glass surface with a solution of gum made sensitive with bichromate of potash and print it under a negative. After the image is thus produced, dust it over with minium or red lead. The red picture obtained is fixed and burnt in the usual way. The easily soluble red glass so obtained should be treated with strong sulphuric acid, to produce a white matt. The picture will appear by transmitted light as a positive.—HERMAN NEUHAUS.



A Modest Home at a Modest Price

General plans for the construction of an
all-the-year-around residence or a camp

By Charles A. King

IN comparison with the past the present does not seem a propitious time to enter upon a building proposition, but there is slight assurance that future conditions will be much better.

Just how much of a house may be built for a given amount of money is a problem upon which many who contemplate building will welcome light. By applying the cubage method of estimating we can approximate the size of house within which reasonable liberties may be taken with the plan, but it is not recommended as the basis of a contract.

In the suburbs of the more important cities an expensive wooden building will cost about 17 cents per cubic foot at the present time. Concrete, stucco, and hollow tile will cost about 20 cents, while a brick dwelling of the better type will cost about 10 per cent more. In ordinary times a well built house of the type shown in the sketch may be put up for from 8 to 12 cents per cubic foot, depending upon the cost of labor and materials in different localities, but at present the cost would range from 10 to 15 cents. Probably 14 cents per cubic foot would pay all the bills connected with the erection of such a dwelling in the vicinity of most cities, while present building conditions prevail.

We will say that \$2500.00 is the maximum amount which can be expended in the

erection of such a house with the essential conveniences and some luxuries, finished, ready for occupancy. If we divide \$2500.00 by the price per cubic foot, say 14 cents, we will find the cubic contents of a house which can be built for that sum; in this case, 17,857 cu. ft.

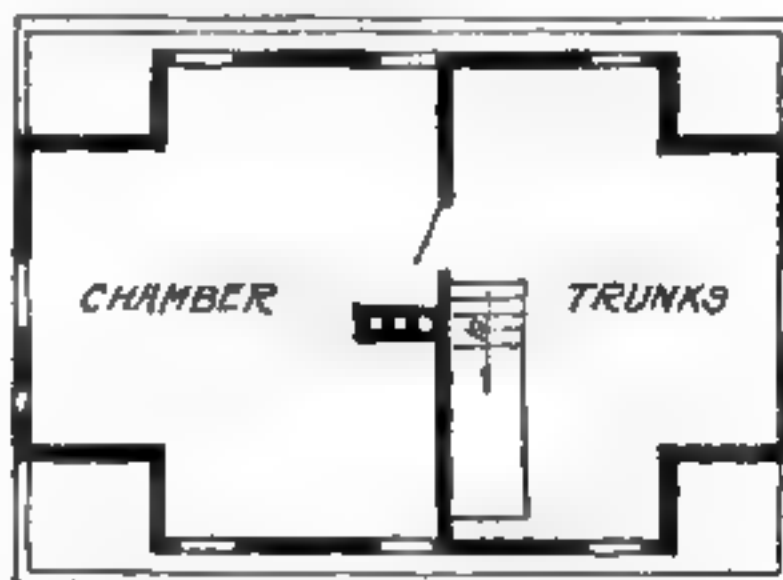
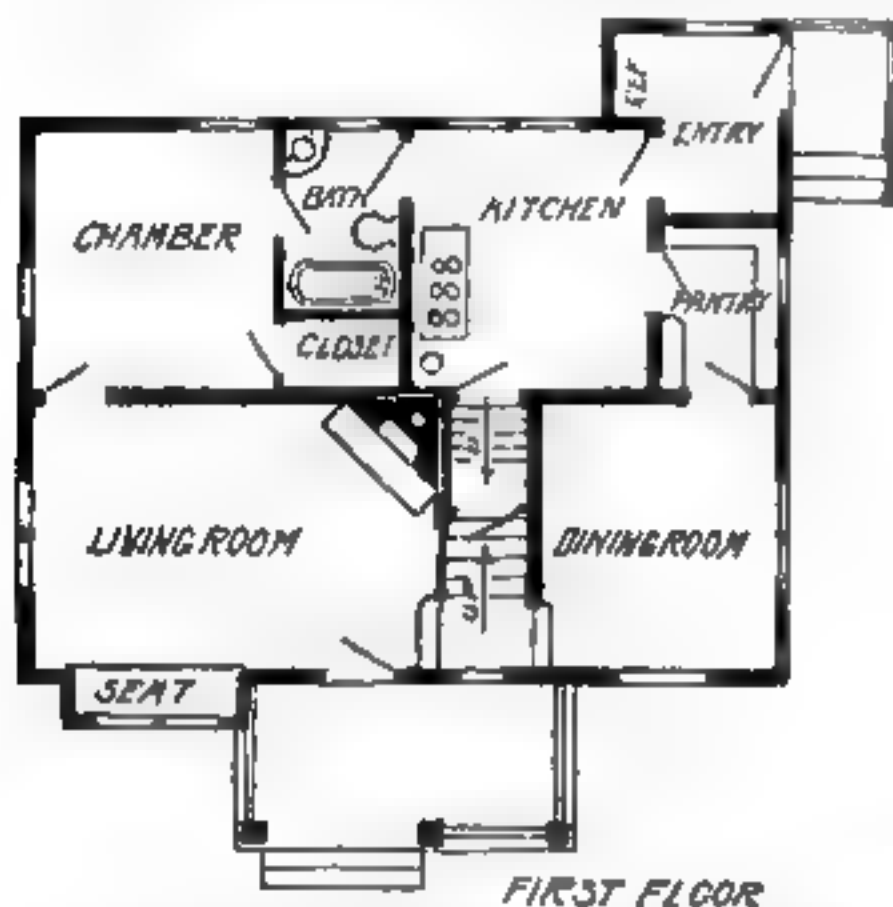
The basis of an estimate of this sort is the area enclosed by the average outside dimensions, exclusive of the porches. By dividing this area by the distance from the cellar floor to a point which will include one half the average height of the roof from the plate line to the ridge, say 23 ft., we find 776 sq. ft. as the possible area of the ground floor, the size in this case, 24 ft. by 32 ft. 4 in., exclusive of all projections beyond the rectangle, as shown in the accompanying floor plans. Allowing 120 sq. ft. for the area of the pantry, bathroom, stairway and chimney, we have 656 sq. ft. the area available for rooms. This may be divided into four rooms containing upon an average 164 sq. ft. each, including partitions, closet and back entrance. A kitchen with an area of 120 sq. ft., a dining-room of 144 sq. ft., and a bedroom of 140 sq. ft., would permit a living-room of about 12 ft. by 21 ft., or containing 252 sq. ft. There would also be a bedroom and trunkroom in the attic, a front piazza and back entrance and porch. With this data the planning of the house is reduced to a matter

of adaptation, arrangement and exterior design.

There are several ways in which the initial cost of such a house may be reduced, or a better house built for the same money. It may be finished to the stage where the family can take possession and save paying rent elsewhere, and the family genius can do most of the work of finishing the rooms himself. Pipes for hot air heating, steam,

nailed directly upon the studding, or where it is not usual to build a cellar or to have more than a post or wood foundation, an appreciable saving may be effected. In localities where prepared or metal roofing has supplanted shingles, and where labor or building materials are exceptionally cheap a more commodious house may be built for the same money.

A camp of the size and type of the sketch,



A general floor plan of the first and second floors of a moderate priced home that can be built for an all-the-year-around residence or may be used with unfinished rooms as a camp in the woods

hot water and gas, and wires for electric lights may be placed in the walls without the fixtures, which may be put in later, or the pipes may be omitted, leaving openings for their future installation, heating the house with stoves and lighting with lamps in the meantime. The pipes for the complete bathroom equipment may be installed and nothing but the seat put in at first, though the location of the bathroom upon the first floor makes it possible to omit everything but the seat connections if desired. Walls need not be papered until the house has thoroughly seasoned and the resulting plaster cracks treated. This is customary in expensive houses for the sake of the permanent condition of the walls and not for economy.

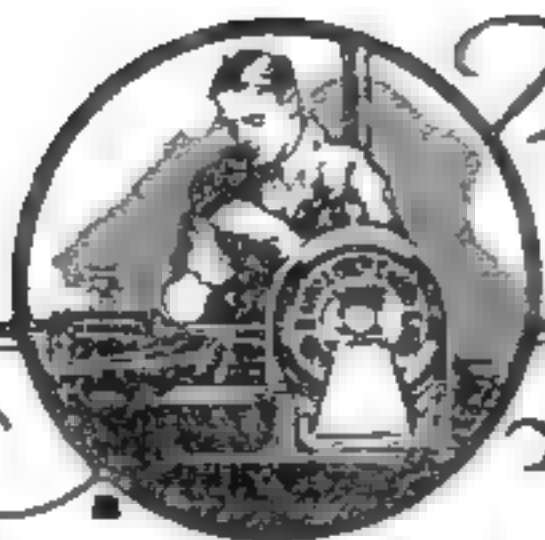
The exterior of the house may receive a priming coat and another coat of paint which will protect it for a couple of years and allow the outside to shrink all it will; it may then be puttied and two coats given which will insure the best possible results.

In sections of the country where the climate will permit the use of drop siding

with unfinished rooms, without a cellar or the conveniences necessary for a year-round residence, can be built for from 5 to 7 cents per cu. ft. above ground in localities where supplies are easily obtainable. At this price economy must be used in the construction, though a piazza may be built the entire length of the front of the house.

Grouping Sheet Music Into Books and Binding Them

IT will be found very convenient to have sheet music arranged in little books, each containing from six to ten selections. For instance, one book may be made up of a group of waltzes; a second may contain a group of songs; a third a group of classical selections; a fourth a group of popular music, and so on. Paper fasteners of the proper size may be used to staple the books, which should then be bound with strips of strong cloth tape. On the cover of each book may be written the names of the various selections it contains.—ALEXANDER V. BOLLERER.



The Amateur - Electrician

And Wireless Operator

Increasing the Efficiency of the One-Inch Spark Coil

THE more advanced amateur usually turns his attention to power transmitters, and consequently there is a lack of reliable data applying to the small spark-coil set. This necessarily works a hardship on the beginner, whose initial equipment generally includes a spark coil. Therefore, a few practical answers to various problems encountered in the operation of the popular 1-in. coil transmitter should prove helpful not only to many newcomers, but also to more advanced operators who are troubled by interference from badly-tuned small stations.

The writer has raised the efficiency of his 1-in. coil transmitter to a point where he can consistently outdistance by more than two miles any 2-in. coil in his vicinity, on a power input of only 15 Watts. Specific working directions for duplicating this set will be given; but a few generalizations must first be considered.

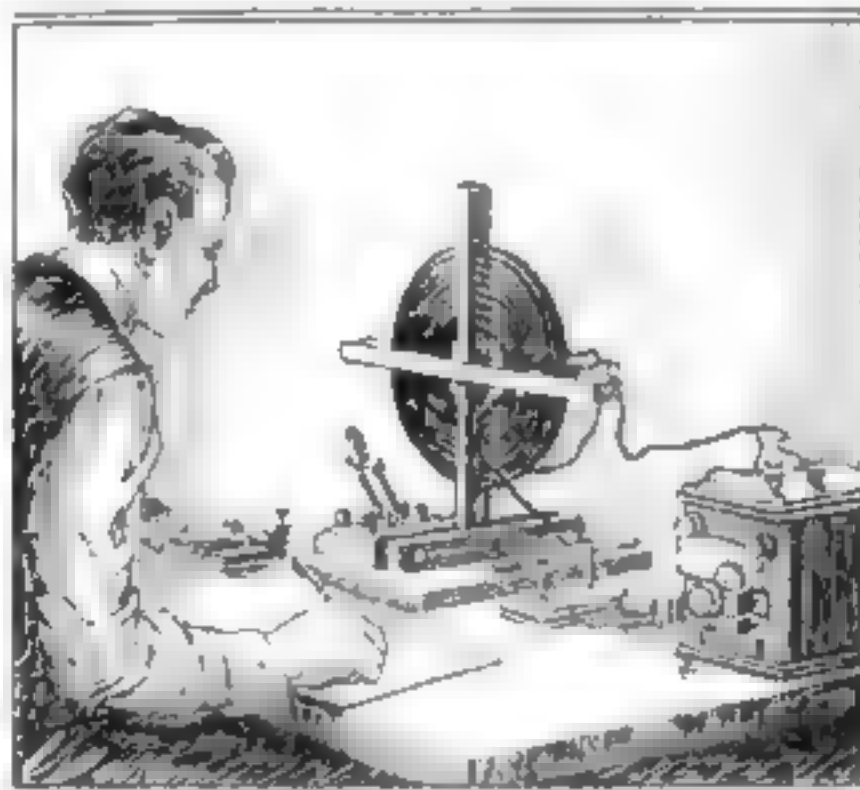
It is a fallacy to suppose that the principles governing the installation and tuning of large sets do not apply to spark-coil transmitters. The author is aware that many beginners possessing small coils have attempted to tune their stations but have abandoned condenser and helix in disgust after noting a considerable decrease in sending radius. Little, if any, advantage as to distance is to be gained by tuning sets using coils smaller than $\frac{1}{2}$ in., but larger

transmitters become vastly more efficient when properly adjusted. I have visited many small stations that were not giving satisfaction, and usually located the trouble in the design or capacity of the transmitting condenser, or discovered that closed and open circuits were hopelessly out of resonance. In one instance a station was found to be using a condenser consisting of sixteen 12 by 14-in. plates

across the secondary terminals of a little $1\frac{1}{2}$ -in. spark coil. The spark discharge was spectacular, yet the range of the station was less than two miles. The error of regarding the oscillation-transformer, or helix, as a device to raise the voltage of the high-frequency currents traversing the open circuit seemed especially widespread. The owners of the stations had tuned them by varying the positions of the helix

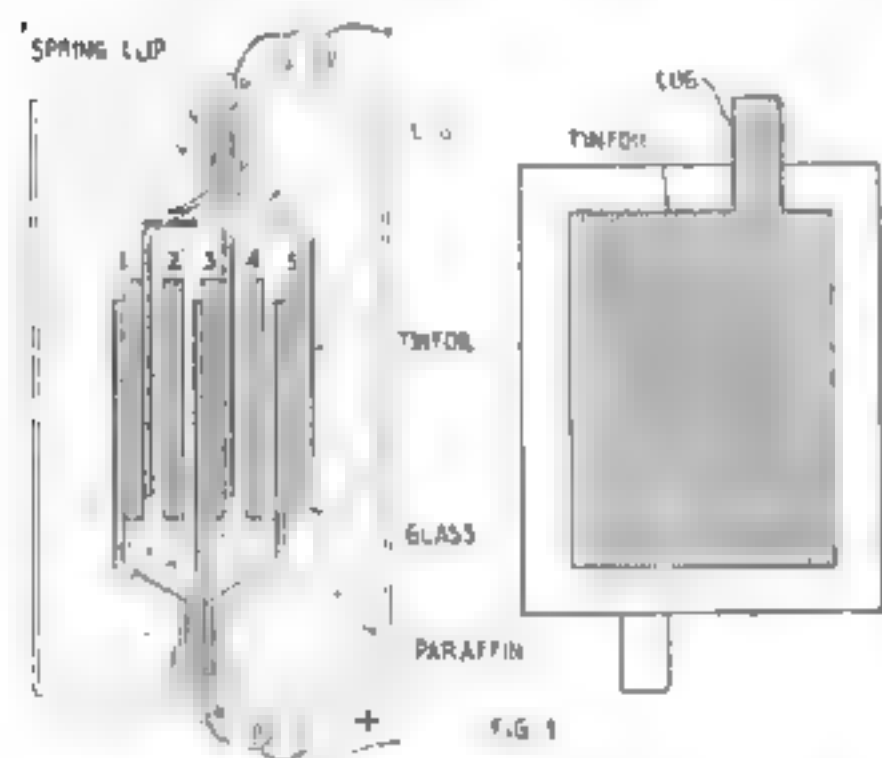
clips until sparks 3 or 4 in. long jumped a gap inserted in the lead-in. Such evidence should convince the skeptic that haphazard application of the principle, not the principle itself, is responsible for the poor results sometimes obtained by "tuning" a station of this type.

Tests have convinced me that in connection with a spark-coil transmitter it is best to use a conductively-coupled pancake helix having a number of inductive turns in both the primary and the secondary. This necessitates the use of a transmitting aerial not more than 40 ft. in length (T-aerials excepted) with a lead-in not longer than 30 ft., and a very small condenser in



The compact arrangement of the one-inch spark coil when set upon the operator's table

the closed circuit across the secondary terminals of the spark coil. The advantage of this arrangement is in line with the idea that a transmitter operates best at a wavelength $1\frac{1}{2}$ times the natural period of the aerial. Many amateurs extend their antennas to greater lengths, use only one or two turns in the secondary of the oscillation-transformer, and then wonder why their



Transmitting condenser constructed of glass plates coated on both sides with tinfoil

range is not all it should be. It may be interesting to note that the author uses a 4-wire inverted L aerial 55 ft. high and only 35 ft. long on the flat top portion.

The aerial must be very carefully insulated. Use ball insulators on each wire in the flat top portion, electrose strain insulators on the spreader bridles, and porcelain cleats on the sway guys.

The lead-in deserves as much attention as the aerial proper. Bunch the wires immediately beneath the aerial and connect with a No. 4 copper wire, insulated from the rod by large porcelain knobs. Unless already insulated, it is best to wrap the wire with electric tape where it comes into contact with the knobs. The wire should be passed through a porcelain tube when it enters the operating room. All joints must be securely soldered. The commonest cause of weak, swaying, fading signals is a loose, corroded connection in the aerial or lead-in.

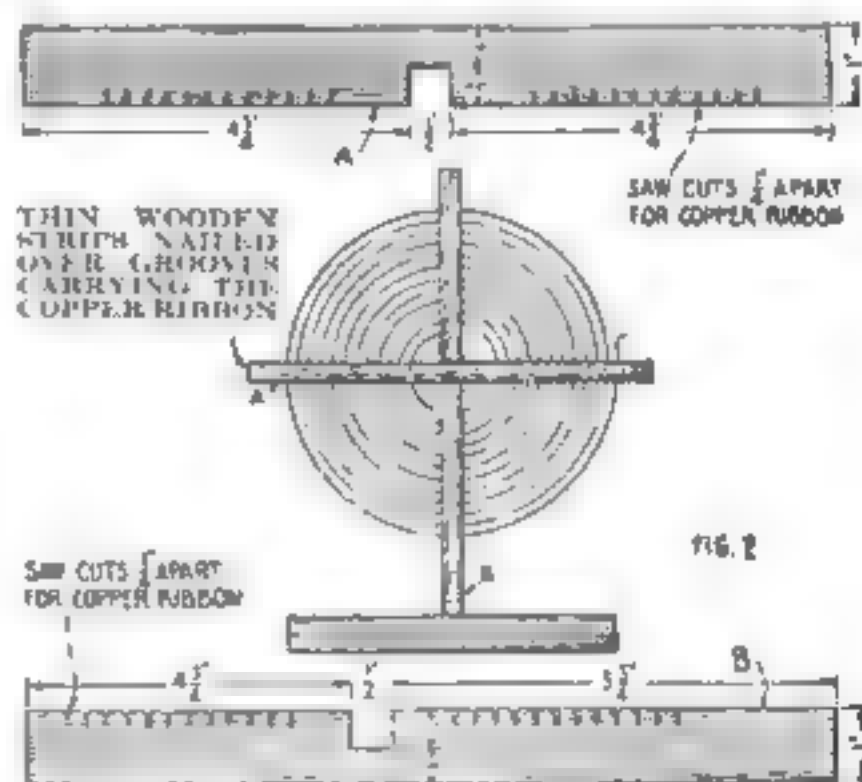
As the slate base of the ordinary lightning switch is absolutely unfitted to prevent leakage into the ground of the high voltage currents, it is important that defective insulation at this point be remedied by raising the base on fiber strips.

The saying that "a good ground is as

essential as a good aerial" is true, for an indifferent ground connection severely cripples any station. One of the reasons why ship stations can transmit so much farther with a given amount of power than many land stations is that it is possible on ship-board to secure a perfect ground. The range of the writer's station was increased thirty per cent. by running extra ground wires to the watertank up in the attic, to the gas-pipe in two places, and to the heating system as well. This was a great surprise, as I had been using a connection to the water pipe on the street side of the meter, that I considered excellent. Stations situated on hilltops where there is little moisture in the ground due to downhill drainage must take special pains to secure an efficient ground.

Never forego an opportunity to reduce the resistance of any of the connecting wires, the lead-in, or ground connection. The greater their conductivity, the greater the radiation, and an increase in the sharpness and purity of the emitted wave will be noticed.

Now for the set itself. We shall first consider the construction of the transmitting condenser. With hot water remove the emulsion from five $3\frac{1}{4}$ in. by $4\frac{1}{4}$ in. photographic plates, and coat three of them on both sides with tinfoil, leaving a

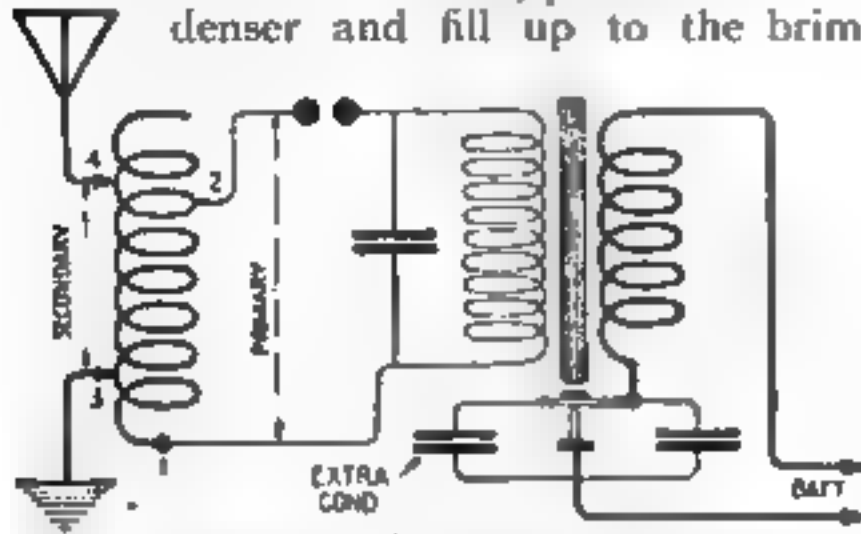


The helix has twelve turns of copper ribbon placed in notches sawed in cross sticks

margin of $\frac{3}{8}$ in. around the edges. As an adhesive use orange shellac, not white shellac. Next paint the two remaining plates with the liquid, and when it has become sufficiently dry to be very sticky, pile the five plates together as shown in Fig.

1. Plates 2 and 4 have no tinfoil coatings. Press firmly together, and bind with friction tape. Connection with the lugs is made by the use of spring clips, which may be bent out of copper ribbon. The condenser is sealed into a wooden case with paraffin so that it is entirely surrounded by the wax. The bottom of the container should first be covered with melted paraffin.

When this cools, put in the condenser and fill up to the brim.



The instruments are arranged compactly and the hookups shown are used to tune the circuit

Brush discharges (the fine violet spray noticed around the edges of poorly built condensers) are thus eliminated, and this source of energy loss is done away with.

The helix has twelve turns of $\frac{3}{8}$ -in. copper ribbon. Necessary dimensions are given in Fig. 2. Great care must be exercised in making the slits for the ribbon. Clamp pieces *A* and *B* side by side and cut them simultaneously with a fine scroll saw.

In wiring up the set use heavily insulated rubber-covered copper wire not smaller than No. 12. While copper or brass ribbon is an efficient conductor of high tension, high-frequency currents, it will be found rather clumsy to handle. Arrange the instruments compactly, and use the hookups outlined in Fig. 3. Short leads are desirable, but do not jam the instruments too close together.

To true the set to 200 meters, place clips 1 and 2 at the points indicated in Fig. 3. The closed circuit is then tuned to 200 meters. To bring the open circuit into resonance with it, place clip 3 as indicated and vary the position of clip 4 until a receiving station receives the emitted signals at maximum intensity. The wavelength of the set when tuned in this manner may be 2 or 3 meters out of the way, but this is near enough to the legal requirement for all practical purposes. It must be understood that these directions apply only to this particular set where the

closed circuit has been calibrated in advance to 200 meters. If a condenser of different capacity or a helix of different dimensions or design than that described is used, these turning instructions become useless.

Many experimenters experience considerable difficulty in adjusting the vibrator on the spark coil. Stiffening the vibrator-spring with a wad of paper placed just behind, but not attached to the soft iron button, is effective in producing a moderately high, musical tone. Sometimes the rapidity of make-and-break can be increased by demagnetizing the soft iron button. This is heated red hot and plunged into water, the process being repeated several times. Sparking at the contact points, which causes a ragged note, can be minimized by shunting an additional condenser having about 300 sq. in. of tinfoil, across the vibrator. Linen paper instead of glass is used for the dielectric. Do not try to produce a 500-cycle pitch with the vibrator; you will only wear out the platinum contacts, and your range will fall off considerably. A clear-cut, solid note resembling that of Cape Cod will give the best results.

Rotary-gaps cannot be used with spark coils. Good quenched gaps are efficient, but they do not give the spark a higher pitch than the ordinary straight gap, and their construction is much too difficult for the average experimenter to undertake with his limited workshop equipment. If not designed with exactness and built with great mechanical precision, very serious energy losses result. At the present time there is no moderately-priced quenched gap suitable for small spark coils on the market.

Judging from his own experience and from general observation the author is convinced that owners of 1-in. spark-coil transmitters who apply these principles to their equipments will save themselves much time and expense and may feel confident that their senders produce a minimum of interference.—SUMNER B. YOUNG.

Automatic Cut-Outs for Use in Charging Storage Cells

THOSE who charge storage batteries realize the need of some kind of protection for the batteries during the charge in case the voltage of the charging dynamo should fall below that of the

storage battery. As most charging generators are wound with a very low resistance in the armature this would of course put a short circuit across the battery and ruin it in a very short time. In some

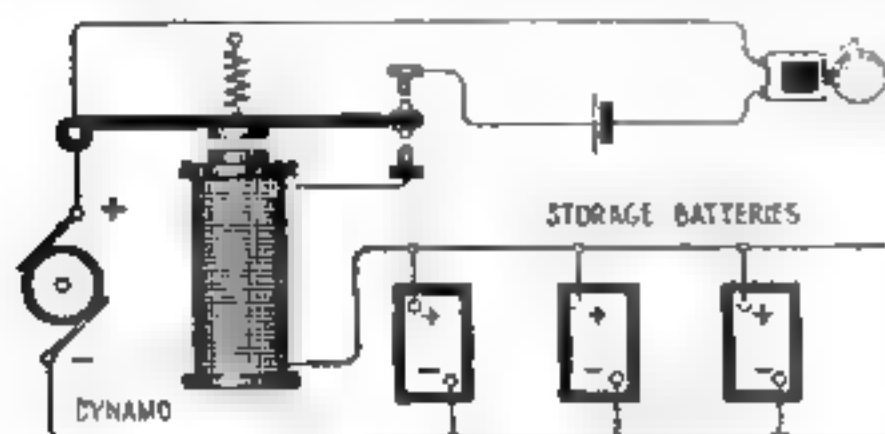


FIG 1

A low resistance electromagnet in series with a charging circuit to prevent a short circuit

cases it would reverse the polarity of the dynamo. A very good way to prevent such occurrence is to insert a low resistance electromagnet in series with the charging circuit that will attract an armature which forms a part of the charging circuit, as shown in Fig 1.

As seen in this diagram the armature, when against its front stop, forms the circuit from dynamo to the batteries. The magnet will hold the armature in contact as long as the voltage of the dynamo exceeds that of the battery, but as soon as the voltage becomes equal, the magnet becomes de-magnetized and the battery circuit is consequently broken by the armature being withdrawn with a spring against its back stop, which makes a second

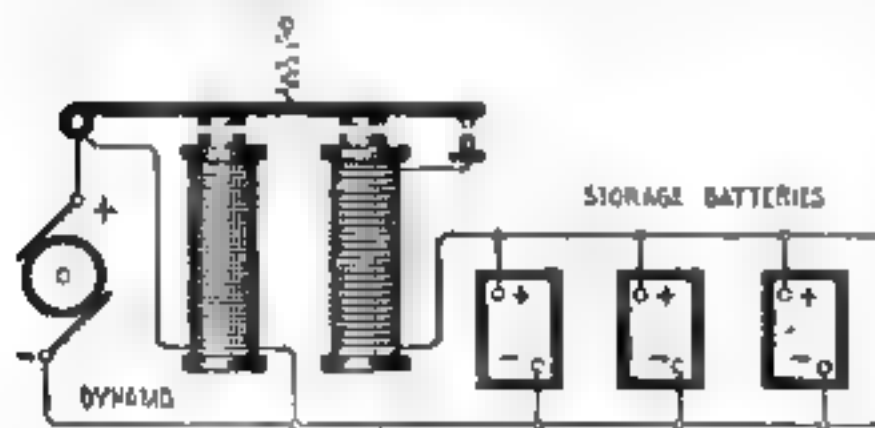


FIG 2

Here we have one coil of low resistance wound with No. 12 wire in series and another coil wound with many turns of fine wire

contact with a circuit having a local battery with a bell for giving the alarm. This arrangement, however, has one drawback in that its armature has then to be re-set by hand to complete the circuit when the dynamo is again started. In Fig. 2 is shown another diagram whereby

this function is performed automatically. It will be seen that another coil has been added. Here we have one coil of low resistance wound with No. 12 wire in series, and another coil wound with many turns of fine wire, No. 34 or 36, but connected in shunt. This shunt coil takes very little current and serves to draw the armature down to its front contact and close the battery circuit as soon as the generator has acquired sufficient speed to energize it.

These diagrams are drawn simply to show the theory, but the finished article adapts itself admirably to the ordinary Morse telegraph relay, with only one change which will probably have to be made in relay. Procure a Morse telegraph relay from any electrical house. These

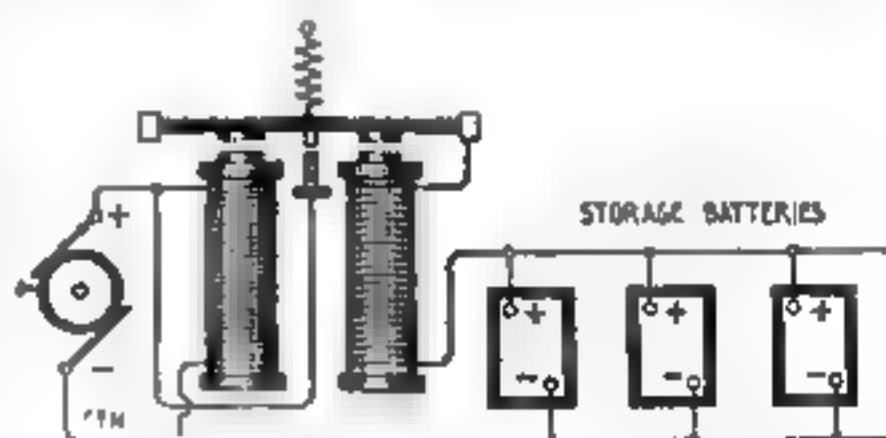


FIG 3

A telegraph relay having both coils rewound and connected in the line for actual use

are generally wound for 35 or 150 ohms. Rewind both coils, one with as much No. 34 or 36 wire as it will hold neatly, and the other with No. 12; or, if your charging current exceeds 30 amperes, wind it with No. 10 wire to avoid undue heating which would char the insulation. As most relays have a small piece of No. 30 wire, which forms a flexible connection between the armature and its bearing to preserve the contact, this will have to be removed, as it will not be able to carry the large current for which it will now be used. The plan is to remove this small piece of wire and insert a piece of No. 14 wire in such a manner as not to give the armature too stiff a movement. However, this may not be necessary if the trunnions of the armature fit snugly in their bearings and preserve a good contact at all times. When you have both coils wound make the connections as in Fig. 3, which shows the apparatus in service. You may be able by the use of these diagrams to construct this apparatus without a Morse relay.—W. A. POLING.

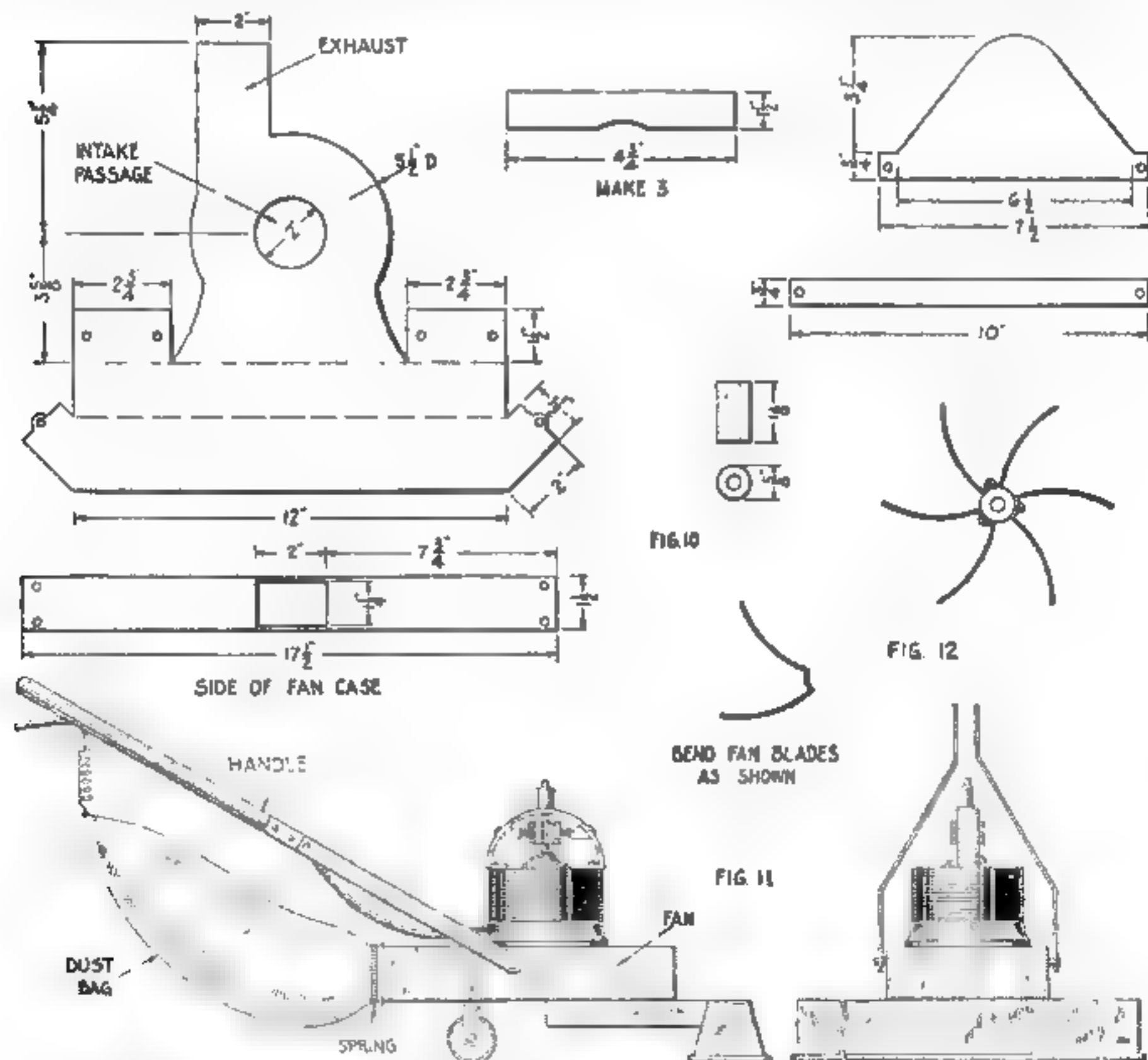
A Practical Electric Vacuum Cleaner

II.—The construction of the motor was explained last month. Now comes the housing problem

By L. E. Swindell

THE shoe is constructed of black sheet iron $\frac{1}{16}$ in. thick. The necessary dimensions are given in Fig. 10. The patterns should first be cut out of cardboard and then traced on the sheet iron to obtain the best results. The parts are cut out with a pair of tinner's snips. They are then assembled as in Fig. 11. A little study will show how they fit together. The holes shown indicate where the parts are riveted together. After riveting, all the joints are

soldered to add to the rigidity and make the fan-case airtight. Where the edges of the shoe touch the floor, U-shaped pieces of thin iron are used to enclose them. These are soldered in place. If desired, a rotary brush may be placed inside the shoe, which will materially aid in picking up lint, thread, etc., from the floor. On each side of the fan-case is a projecting piece of $\frac{3}{8}$ -in. iron rod $\frac{3}{4}$ in. long, which fits into a hole in the lower end of the handle.



Patterns for cutting the sheet metal to form the airtight suction-box and shoe which inclose the fan of the motor, and the manner of shaping the fan blades and attaching the handle

These pieces are to be riveted to the underside of the fan-case. A fiber wheel 2 in. in diameter is turned in a lathe and fitted to a U-shaped piece of strap iron $\frac{3}{4}$ in. wide. Now rivet the wheel-support to the underside of the fan-case in such a position that the wheel will support about one-half of the weight, the other half resting on the shoe.

The fan, Fig. 12, is cut out of sheet iron $\frac{1}{32}$ in. thick. There are six blades, in pairs. The three pieces comprising the blades are to be firmly screwed to a brass hub, the dimensions of which are given. For added safety it is well to sweat the blades to the hub with solder to prevent them from becoming loose. The fan is secured to the shaft by means of one of the screws used to hold the blades to the hub, the screw being $\frac{1}{16}$ in. longer than the others for this purpose.

The handle is about 1 in. in diameter and $2\frac{1}{2}$ ft. long. Two pieces of strap iron are bent as shown and secured to the handle by means of two small bolts. On the under side of the handle a groove is cut to receive the conductor cord. A small one-point switch should be mounted on the upper end of the handle to control the motor. The connecting cord should be 30 ft. long, so as to permit of a large radius of operation from one electric socket.

The dust bag is of any closely woven material, 30 by 8 in., of the shape shown. On the smaller end a coiled spring is sewed. This fits over the end of the exhaust of the fan. The other end is closed by a 6-in. paper clip, the latter being supported by a small coiled spring fastened to the handle.

The mechanical details of the machine are now complete. The motor and handle should receive two coats of black enamel, and the shoe two coats of aluminum enamel. If care has been exercised in the construction of the vacuum cleaner it will present a very neat appearance and give as satisfactory service as any electrically driven machine of its size.

Making an Electric Furnace for the Laboratory

IT is often desirable to use a heat above that of the ordinary bunsen burner, for instance, to melt silver or gold or make calcium carbide or carborundum. To do this on a small scale, the electric furnace herein described will be found convenient.

The material necessary consists of two standard-size fire bricks, two $\frac{3}{8}$ -in. arc light carbons 6 in. or more in length, and four porcelain knobs for supports.

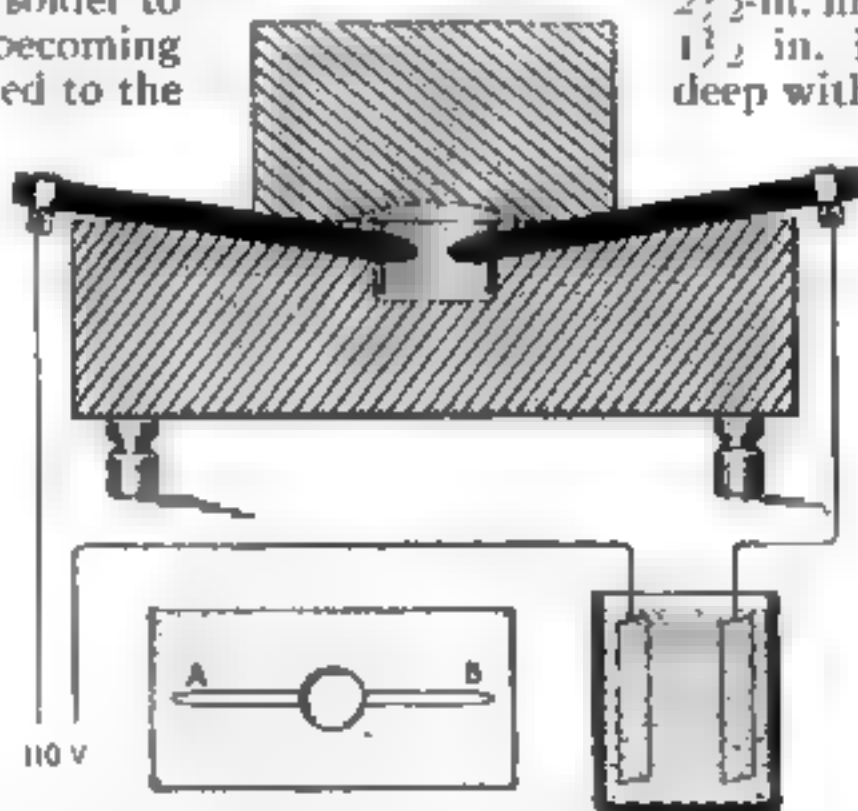
At the center in the top of a 9 by $4\frac{1}{2}$ by $2\frac{1}{2}$ -in. fire brick gouge out a hole $1\frac{1}{2}$ in. in diameter and 1 in. deep with a cold chisel, then cut grooves as shown at A and B. These should extend from the surface $\frac{1}{2}$ in. from either end to the hole at the center, where they are $\frac{1}{2}$ -in. deep and of sufficient width to allow the carbons to slide freely.

The cover brick is about $4\frac{1}{2}$ by $4\frac{1}{2}$ by $2\frac{1}{2}$ in. This should be gouged out slightly concave at the place in the bottom which is over the melting pot. This is

done to help reflect the heat into the melting pot. The furnace is connected with a 110-volt circuit through a water rheostat.

A water rheostat capable of keeping the furnace running for an hour and a half on 8 amperes can be made by immersing two copper strips in a vessel containing at least $1\frac{1}{2}$ gal. of water. Add enough ordinary table salt to allow sufficient current to pass through so an arc can be struck when the carbons are touched together. Then insert an ammeter in the circuit, strike an arc and then add more salt until the ammeter reads five or six amperes. If it is desired to run the furnace for a longer period the rheostat should be built accordingly.

To make carborundum crystals, mix the following: 2 parts sand; 3 parts carbon, (coal or coke); 1 part sawdust and a little common salt. Heap this mixture up around the carbons in the melting pot of the furnace, strike an arc and allow it to run for four or five hours.—E. R. THOMAS.



Small electrical furnace to melt the more precious metals and for experimental use in making calcium carbide and carborundum

Wireless Work in Wartime

IV.—The complete forms for sending official messages

By John L. Hogan, Jr.

THE complete international Morse code, including numerals and the more important punctuation marks, was given in preceding articles of this series. The second article, appearing in the September issue, explained the simpler methods of calling and answering by radio, as well as the plan usually followed in acknowledging the receipt of radiograms and in securing repetition of words or portions of messages not correctly received. The complete forms for sending official messages have not been discussed, however.

Radio telegraphic transmission is for the most part carried on according to a series of regulations agreed upon at the London International Radiotelegraphic Convention of 1912. This convention and the set of rules there formulated are given in full in a pamphlet entitled "Radio Communication Laws of the United States," which may be secured for fifteen cents from the Superin-

it is perhaps best for the student to give his attention to the methods approved by the Director of Naval Communications. These are given very fully in a "Handbook of Regulations" of the U. S. Naval Radio Service which was issued about four years ago and which is brought up to date by means of supplements issued from time to time. Additional information may be found in the Navy's "Commercial Traffic Regulations" of 1915. The scheme used is an elaboration of the London Convention and agrees with its rulings.

In the first place, a station wishing to communicate with another, first sends out a radio call by making the attention signal (dash-dot-dash-dot-dash), the call letters of the desired station three times (KUR KUR KUR, for example), the word "de" (meaning "from"), and then its own call letters three times (for example: KSW KSW KSW). This is usually followed by

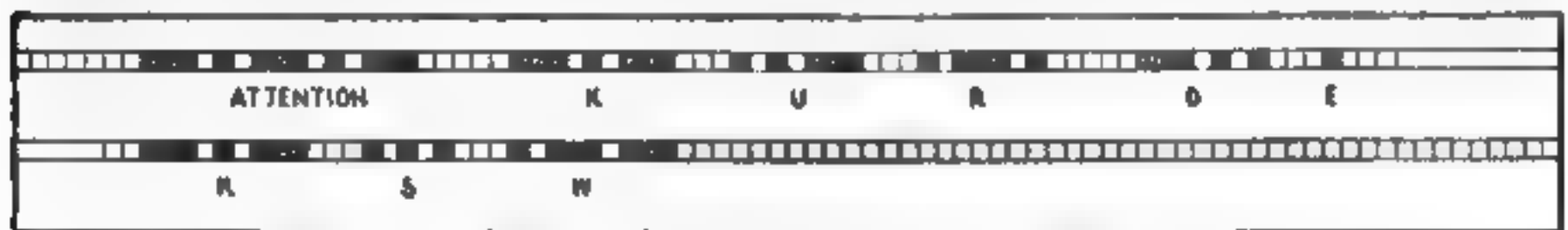


FIG. 15

A station wishing to communicate with another first sends out a radio call by making the attention signal, call letters of the desired station three times, then its own letters three times and a cross

tendent of Documents at Washington, D. C. Every student of radio should get a copy of this booklet, since it contains, in addition to the report of the convention, much valuable information with regard to the licensing of radio stations, radio operators, the Department of Commerce Districts for the supervision of radiotelegraphy, etc.

Although the London Convention is very specific as to certain of its rulings, it does not give in detail the methods to be followed in transmitting messages of various types. Each radio organization has certain peculiarities in this respect. One company will habitually use a system of symbols which are not entirely adopted by other radio administrations; but, fortunately, these variations are usually not serious enough to cause much difficulty.

Inasmuch as the Navy Department is in entire charge of radio work during wartime,

the finish signal (dot-dash-dot-dash-dot), although such procedure is not strictly official in the call. The station called, on hearing the signals, replies by giving the attention signal, the call letters of the calling station three times, the word "de", its own call letters three times, and, if ready to receive, the "Go ahead" signal ("K"). If the station is not ready to receive, instead of sending "Go ahead," the operator signals "Wait" (dot-dash-dot-dot-dot) or some one of the official abbreviations such as QRX (which means "Stand by; I will call you when required") or QRW (which means "I am busy; please do not interfere"). The list of abbreviations is given in full on page 46 of the "Radio Communication Laws of the U. S." above referred to, and forms a very important supplement to Article XXII of the Convention regulations.

When stations calling each other are close by, or within easy communication distance, it is not necessary to repeat the call letters three times either in calling or acknowledging. For instance, a so-called "short call" might be as follows:

"Dash-dot-dash-dot-dash KUR de KSW" and the acknowledgment or reply simply

dot). This "End of message" signal is written as a cross (+), and, as indicated before, is often used at the end of any transmission whether of a complete message or not. The double-dash (=) signal, dash-dot-dot-dot-dash, is used to separate the preamble from the address, the address from the text and the text from the



FIG. 14

How the "break" or double-dash is used to separate the preamble from the address. Note the extra space between the figures for the hour and those for the minutes in the space for time filing

the letter "K," meaning "go ahead." Such shortening of the time used for calling and establishment of communication is very helpful in working radio where much traffic is to be handled, since every minute saved for actual messages increases the number of useful words which can be put through in a given time. The formal symbols should never be abbreviated to the point where uncertainty creeps in, however, for in such cases more time is lost in repeating than would have been taken for a complete transmission in the first place.

The Authorized Message Form

Assuming that the call and reply have been given, the acknowledging station indicating by "K" that it is ready to receive, the calling station may begin its transmission of messages. According to the Naval system (which is similar to that in use else-

signature and should never be omitted.

The preamble referred to needs further explanation. It contains the necessary information for the operators' records, and usually consists of seven parts, as follows: (1) prefix, (2) station of origin of the message, (3) number of the message, (4) the signature-letters of the sending or receiving operator, (5) the "check," or number of words in the message, (6) the date and hour the message was filed for transmission, and (7) the route or "Via," giving the call-letters or the stations which have relayed the message up to that point. The prefix is a code-letter symbol, such as "TR" for a position report giving the location of a ship at sea, "OFM" for an official message, "SVC" for a so-called "service message" (which is one sent between stations and having to do with handling messages, accounts, traffic regulations, etc.),

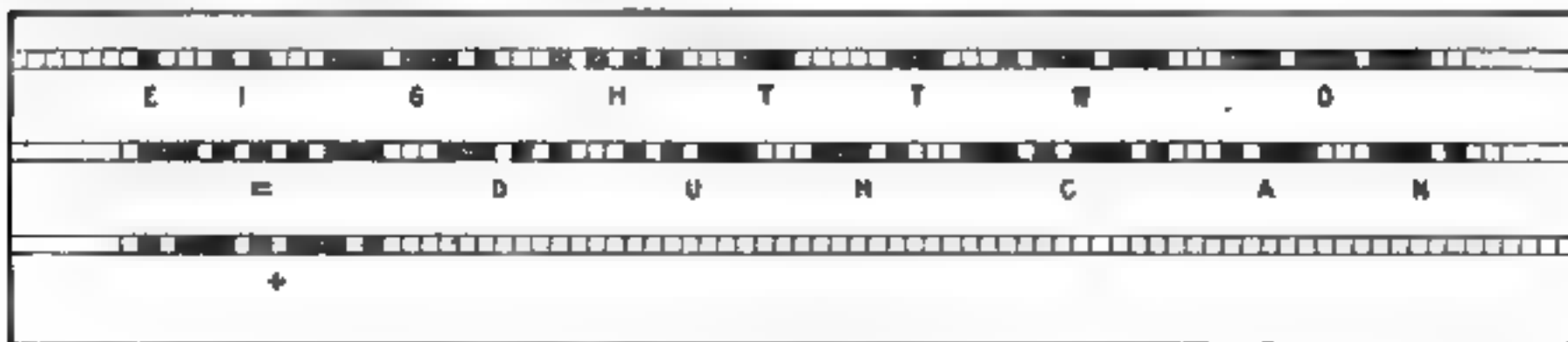


FIG. 15

The close of the specimen message, showing the double dash separating the text from the signature, and the cross, or "end of the message" character, spelled out in the usual way

where) the message transmission may be divided into six main parts, as follows: (1) Attention signal, (2) Preamble, (3) Address and route, (4) Text, (5) Signature, and (6) End of message (dot-dash-dot-dash-

"MSG" for a private or unofficial message, or "RADIO" for a commercial message.

The name of the station (2) is spelled out, as is the day of the month under (8)—the name of the month is omitted. The num-

ber of the message, the "check" or number of words, and the hour in (8) are given in figures, the hour being followed by "am" or "pm." Sometimes the signature letters of the sending operator are merely written on the blank and not transmitted, but this omission may give rise to confusion between the number of the message and the "check."

A Specimen Message

Let us consider a typical message to be transmitted from Philadelphia (call letters NAI) to New York (call letters WHB), on commercial matters, and sent by an operator at Philadelphia who has adopted the letters XM as his personal identification signature—letters or "sign." This might be as follows:

Philadelphia, Pa., Nov. 3, 1917,
Filed 11.03 a m
To James Doherty,
Equitable Building, New York.
Express twelve thousand item seven
drawing eight two.
Duncan.

As sent out by the Philadelphia operator, assuming it to be the fifth message sent to New York that day, it would be as given below. Each section is given separately, so that it may be compared with the list of parts just stated.

"Dash-dot-dash-dot-dash
RADIO
Philadelphia
5
X M
14
THIRD
1103 a m
Dash-dot-dot-dot-dot-dash
James Doherty Equitable
Building New York
Dash-dot-dot-dot-dot-dash
Express twelve thousand item seven drawing
eight-two
Dash-dot-dot-dot-dot-dash
Duncan
Dot-dash-dot-dash-dot

Taking up these lines in sequence, we find first the attention signal and then the prefix. This is followed by the station's name, spelled out, and by the number of the message (namely, 5). Next come the operator's sign and the check, or number of words in the message. It is difficult to see just how the specimen message contains fourteen words until one knows that the

check includes the words in the address, text and signature (according to "cable count") and notes that names of cities such as New York and New Orleans and states such as West Virginia are counted as single words in addresses but as two words when they appear in the text. The rest of the message should be perfectly clear without further explanation, though it may be noted that no relays or via's, and no route for addressing appear in such a simple transmission as that assumed for this example.

Sending Messages in Sequence

When the sending station has several messages to transmit to the same receiver, the operator may follow with the second and third immediately after the first; it is not a good plan to send too many in sequence without giving the receiving station an opportunity to acknowledge and ask for any corrections or confirmations which may be necessary. After sending one or two messages the sending operator should "sign off" with his station call and make the "go ahead" signal ("K"), after which the receiving station will call and send "R R R" if he has received everything correctly or "? ? ?" to indicate repetitions desired. The method of indicating partial repetitions necessary to fill in doubtful words or phrases was indicated in the September article, and need not be given again here. When all messages in both directions have been transmitted and satisfactorily received, the

signal Dot-dot-dot-dash-dot-dash, which means "finished," is sent out by both stations.

Complicated as all this may seem to the beginner, it is a system of communication which is quickly learned and which contains little or nothing that is not essential when many different stations are involved in the traffic system. Naturally enough, when two plants (such as Sayville and Nauen) communicate with each other exclusively it is possible to eliminate a large part of the preamble. Messages may be sent without confusion by giving nothing but the num-



Radio waves sent in all directions from several stations may overlap and create considerable "interference"

FIG. 16

ber, the check, the address, the text and the signature. Similarly, when a number of relaying stations or a complicated route is involved, the preamble will have to be even more extensive than that given in the sample message. All these matters will develop as practical operating is taken up, but it is essential that the student appreciate thoroughly as much as has been given of the routine of message handling.

Interference in Radio

Thus the matter of forms of transmitting may be disposed of for the time being. By following out the system as outlined, the student will soon become accustomed to the necessary formalities and will begin to recognize the portions which may be omitted under some particular circumstances without causing confusion. Having this in mind, and remembering that the matter transmitted in addition to the mere address, text and signature is necessary to keep a proper record of the messages and to make a correct accounting of its costs of transmission, the learner may pass on to one of the most interesting and important branches of radio operating, namely, the reduction of interference.

In radio telegraphy there are two main classes of interference, both of which tend to make it difficult to exchange messages without interruption. The first of these is that caused by other radio stations, and the second that set up by natural or non-radio electrical disturbances. The second type of interference may be subdivided to some extent, so as to separate troubles caused by lightning, by passing trolley-cars, by dust storms, etc., as will be explained more fully in later articles of this series. The first type, or "station interference" should probably be taken up first.

Reducing Interference Between Radio Stations

Since all radio telegraph and radio telephone stations use the same basic medium of communication, namely, the hypothetical "ether" of space, it is only natural to expect that under some conditions there will be confusion if many messages are passing from station to station at the same time. Speaking very roughly, the use of this same ether by all the stations is somewhat like the use of the same air by a large number of people talking at once. We have all experienced the difficulty of speaking in a noisy crowd. The person to whom we

talk hears not only what we say, but also the voices of ten or a dozen other people who are near by. Unless we speak loudly, or in a tone different from that used by the others, we are not heard clearly. It is much the same in radio. When one station sends its signals out, the waves spread in all directions, and some arrive at the desired receiving point. If a dozen other stations are sending at the same time in the same neighborhood, their waves also reach the receiving station in question. The result is bound to be confusing unless the first mentioned plant sends its signals more strongly, or in a different tone or pitch from that used by the other installations.

Thus the two fundamental ways of avoiding station interference are indicated: (1) by the use of large transmitting power, which corresponds to speaking loudly when in a crowd, and (2) by using signals of a character different from those common to the interfering stations. This second method has been developed to a great extent in the technology of radio telegraphy, and is of course the preferable plan. Its advantages are apparent as soon as one considers that "talking loudly" may get a single set of messages through interference, but is certain at the same time to create still greater disturbance for other transmissions which may be going on simultaneously.

On the other hand, reducing interference by making a distinction between the kinds or characters of signals used helps the other stations in their parallel problems of sending. In succeeding articles, both of these will be discussed in greater detail, and in the next issue experiments on the buzzer telegraph line (described in the earlier installments) will be explained to illustrate various effects of interference and ways to reduce their troublesomeness.

(To be continued)

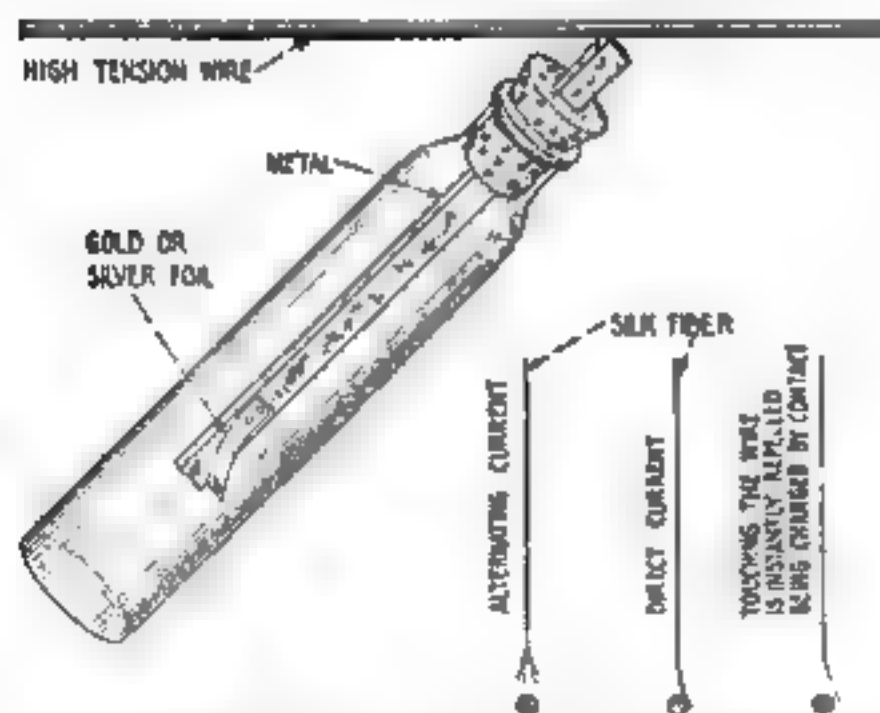
Testing for Trouble That Causes Poor Automobile Lights

THE method of procedure for locating trouble in the lighting system of an automobile is as follows: Test the electrolyte of the battery to see if it registers 1275 or 1300 specific gravity. See that the ammeter registers a charge when the engine is running, otherwise the battery may become discharged. The lamps may be out of focus. A set screw back of the reflector adjusts the focus.

Testing Electric Wires for High Tension Currents

MEN who work on high tension lines of electric service must be certain that the current is turned off from them. As an added precaution against the accidental throwing of the wrong switch they should securely ground the circuit until work on it is finished. Several types of more or less efficient "high tension" testers have been put on the market and most of these have been either of the "gold leaf" electroscope or the more expensive quadrant types. All of these give negative results, because if they do not indicate the presence of high tension voltage, one of two conditions may exist. Either there is no current in the wire being tested, or the instrument does not work perfectly. In the first case the workman is safe, but in the second case, if he relies on the indications of his electroscope his life may be forfeited.

We are not willing to recommend as safe any of the electrostatic types of voltage indicators unless they can be positively checked immediately before and after the proposed observation. I have handled high tension circuits for years and find that a person can make an electroscope for testing the presence of high voltage with no apparatus. This may sound paradoxical,



A fine silk thread used to determine if a high voltage current is flowing in the wires

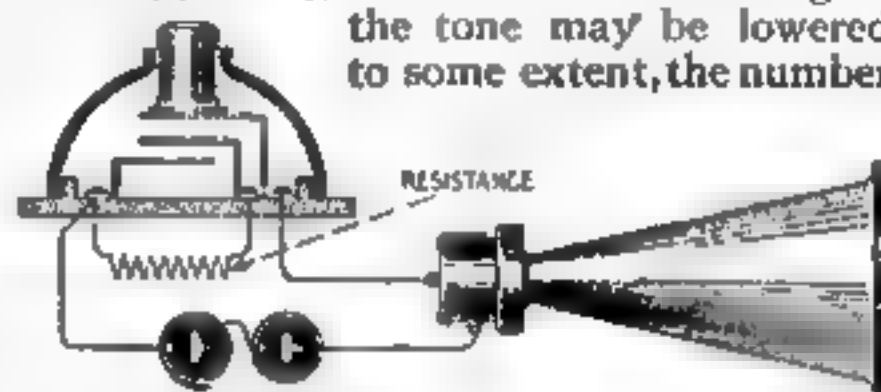
but I use a very fine silk thread pulled from my necktie. If this fiber is sufficiently fine and is held by one end so that the other shall be very close to a high voltage line the free and finest end of this silk fiber will pulsate with the variations in an alternating current.

In close proximity to a high tension direct

current wire the free end of the fine fiber will be attracted toward it. If allowed to touch it, it will become charged and will be instantly repelled. Close and careful observation is necessary in the use of so simple a device. It cannot be depended upon to work in the wind or rain, but as an emergency electroscope it may help some reader. However, we advise a workman to check results on a circuit known to be carrying high voltage and—results or no results—play safe.—T. B. LAMBERT.

Resistance in Circuit to Make Double Tone Automobile Horn

WITH a small amount of resistance placed in the circuit leading to an automobile horn or other electric signal the tone may be lowered to some extent, the number



Changing the tone of a horn with a double contact push-button with resistance in one line

of sound waves being reduced to the amount of resistance used.

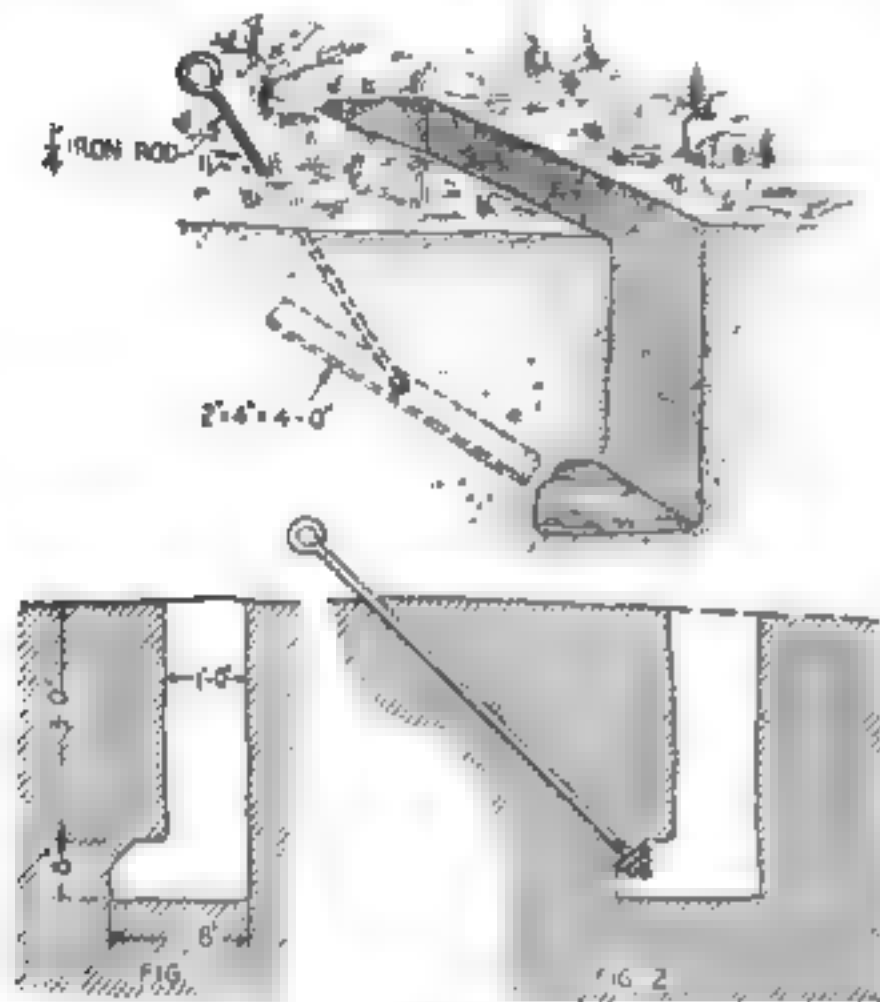
A simple way to work out this problem is to make a double contact push-button, which is clearly shown in the diagram. About 3 ft. of No. 20-gage German silver wire will be about right for the average electric signal such as used on automobiles and motorboats.

A very convenient place for the resistance can be made by cutting a groove around the base of the push-button. When the button is pressed slightly the signal will sound half-tone. Pushing the button all the way down will cause the full tone to be produced.—HOWARD W. PEACOCK.

A Strong Guy-Wire Anchor for Aerial Poles

NO mast is stronger than its weakest guying part, whether that be the guy-wire or the anchor. Only recently an amateur's 60-ft. mast was broken to pieces in a 45-miles-an-hour gale because one of his guy-posts gave way. In this case the amateur used a 3-ft. length of 2 by 4-in. material driven in all but a few inches into the ground. This was easily uprooted by

the wind. Much better results can be had by using an anchor such as is shown in the illustration, which is practically self-explaining. In Fig. 1 is shown the cross-section of the L-shaped trench, which should be 5 ft. in length. A $4\frac{1}{2}$ -ft. length of $\frac{1}{4}$ -in. rod is threaded at one end and an



The trench and manner of placing the anchor for bracing and strengthening the guy-wire

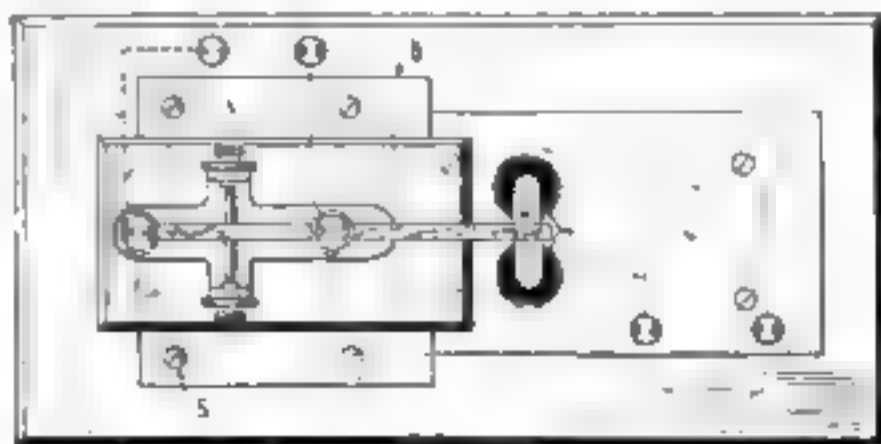
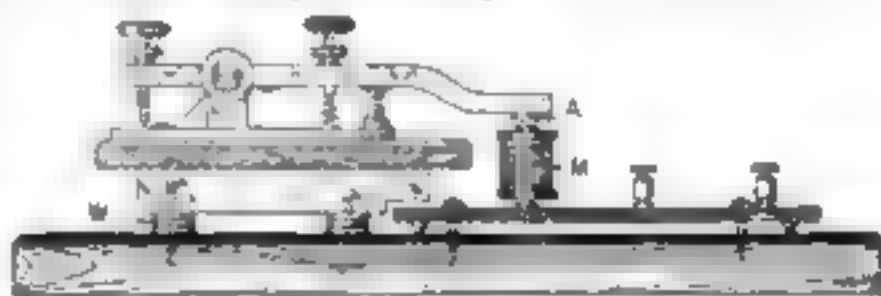
eye is formed on the other end, which is welded at the joint to strengthen it. The rod is then driven in the ground so that it will take the position as shown in Fig. 2. Then a 4-ft. length of 2 by 4-in. stock is bolted on and the trench filled. It is best to place guy-anchors the same distance from the base of the mast as the vertical height of the guy-wire, so that the guy-wire lies at an angle of 45 deg. with the mast.—E. R. THOMAS.

A Magnetic Telegraph Key for the Wireless Operator

THE magnetic key shown in the two accompanying drawings is easy to construct from material usually in possession of the experimenter. At the same time it fulfils all the requirements of an expensive magnetic key. It can be used where it is desired to operate the sending set at some distance from the receiving set, the small control key being at the receiver. This obviates the necessity of extending the power wires. This instrument comprises a regular wireless key (I used a Marconi key)

and a 20-ohm telegraph set. The instrument can be constructed as follows:

First remove the small key from the telegraph set. This is to be placed at the operating table, and used as the control key. Remove the arm, anvil, and support from the sounder, thus leaving nothing but the magnets *M*. Screw the armature *A*, from the arm of the sounder, on the underside of the heavy wireless key-lever where the knob is attached. The knob may be left in place. The next thing is to make a large base about 1 ft. long and about 6 in. wide. Screw on it the base of the telegraph instrument, with the magnets *M* in the position shown in the drawings. Fit out the wooden block *B*, bore two holes through it for the lugs of the key, and fasten on the wires that connect the binding posts with the key. If the key you use has no lugs but is fastened down by screws and has the connections on top, it will of course be unnecessary to bore the holes in the block *B*. The key should, nevertheless, be fastened to block *B* as shown in the drawings. Now with the screws *S* fasten down the block *B*, with the key bolted to it. Place enough washers *W* under the block so that there will be a very small space (about $\frac{1}{32}$ in.) left between the magnets *M* and the armature *A* when the contact points of the key are touching. The key is now ready for use. It will be found that it works easily and requires little current.



A magnetic key for use where the sending set is at some distance from the receiving set

It can be regulated so it will work accurately at the highest speed any operator can send, and will handle currents as high as the capacity of the wireless key that is used with it.—R. H. MAXON.

Making a Selenium Cell for the Laboratory

The resistance of the cell depends upon its size and the spacing of the wires

By Charles E. Mullin

BECAUSE the electrical conductivity of selenium is dependent upon the strength of the light illuminating it, experiments with this substance are particularly interesting. Selenium is not the only substance possessing this property, but it is by far the most sensitive of any yet discovered. A "selenium cell," as the apparatus utilizing this property is called, may be constructed in the shop or laboratory at very little expense.

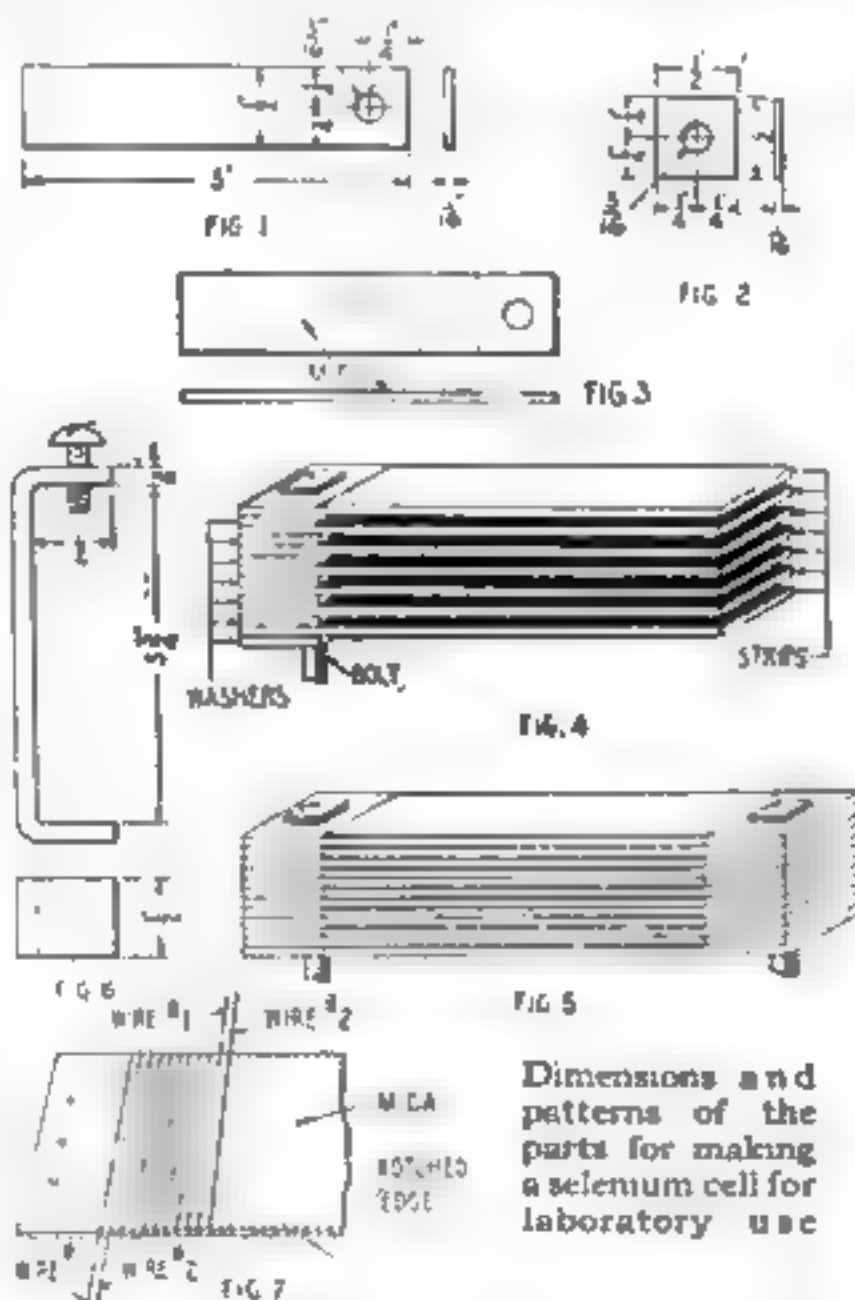
Two types of cells are used, one of a comparatively low resistance, the other of a higher resistance. Both types possess a certain amount of inertia; that is, they do not respond instantly to a slight change of illumination, and this characteristic is intensified with excessive or over-illumination.

It may be well to make a little study of the element selenium before building the cell, as the cell must receive a careful heat treatment after assembling. Selenium is a non-metal of the sulphur group and is generally found associated with it in nature. Like sulphur it exists in several forms, the "A" selenium being that used for the cell. The "A" selenium is a dark grayish black, crystalline solid, possessing a metallic luster. It is insoluble in carbon disulphide and has a specific gravity of 4.8. It begins to melt at 217 deg. C. and is a liquid at 250 deg. C. At higher temperatures in the air it is oxidized.

The "B" selenium, which is the most stable form, is a dark reddish-brown,

specific gravity 4.5, soluble in carbon disulphide, from which it crystallizes in prismatic crystals. It melts at 217 deg. C. and boils at 700 deg. C. A third variety, specific gravity 4.26, is found in two forms, the one electro positive and insoluble in carbon disulphide, the other electro-negative and soluble in carbon disulphide.

It fuses at 100 deg. C. and when suddenly cooled becomes vitreous. When heated to 270 deg. C. and suddenly cooled to 180 deg. C., at which temperature it is kept for several hours, it is converted to the "A" selenium. On heating the "B" variety to 150 deg. C. it changes to the "A" variety, with the evolution of heat. The chemical properties of selenium are very similar to those of sulphur. These properties are given here that the experimenter may better understand the heat treatment which the completed cell must receive in order to render it sensitive to light.



Dimensions and patterns of the parts for making a selenium cell for laboratory use

The material needed for a fair-sized low resistance type of cell is as follows:

- 15 ft. strip brass, $\frac{1}{2}$ in. wide by $\frac{1}{16}$ in. thick
- 2 brass or iron bolts, 4 in. long by $\frac{3}{16}$ in., with 2 washers and 2 nuts each
- $\frac{1}{2}$ oz. selenium, stick preferred
- 1 piece mica, 8 by 12 in., very thin.

Cut from the brass 50 strips, 3 in. long, $\frac{1}{2}$ in. wide by $\frac{1}{16}$ in. thick, as shown in Fig. 1, each with a $\frac{3}{16}$ in. hole, $\frac{1}{4}$ in. from the end. Fifty brass washers, $\frac{1}{2}$ in. square, with a $\frac{3}{16}$ in. hole in the center, should also be cut from the $\frac{1}{16}$ in. brass, as shown in Fig. 2. Fifty strips and washers

will make a fair-sized cell, but the more strips and washers, the lower the resistance of the completed cell. From the mica cut 50 strips $2\text{--}9/16$ in. long by $1/2$ in. wide. One of these strips should be very lightly shellacked to each brass strip, as shown in Fig. 3, so that the end of the mica covers the end of the brass strip farthest away from the $3/16$ -in. hole.

Twenty-five strips and 25 washers are then mounted alternately on each bolt, with the mica always on top, as shown in Fig. 4. The two sections are slipped together and the nuts tightened down, as shown in Fig. 5, so as to hold them securely. A clamp, as shown in Fig. 6, may be made to fit over the center if desired, but it must be insulated from both sections by mica, or fiber, etc.

The top edge surface of the strips should be well smoothed down, with a file or otherwise, so as to be perfectly smooth. The two sections should then be tested with a voltage 5 to 10 times as high as that to be used in connection with the cell, so as to be sure that both sections are insulated from each other. If the insulation is perfect, the smoothed surface should be heated until the selenium melts freely when rubbed over it. Be careful not to get it too hot so as to oxidize the selenium; yet it should be hot enough to cause the selenium to adhere well. The parts of the cell where the brass strips overlap should be given a thin, even coating of selenium, and while hot, the excess may be removed with a spatula, so as to leave a smooth, even surface.

The heat treatment is then given. The cell is placed in an oven and heated to about 260 or 270 deg. C. The temperature is then lowered to about 180 deg. C. at which point it is kept for about 2 hours. The cell is then removed and cooled in the air, the "A" selenium resulting.

The extra nut on each bolt may be used for connections. It is best to mount the cell in a small box with a glass lid, so as to protect it from injury, dust, etc.

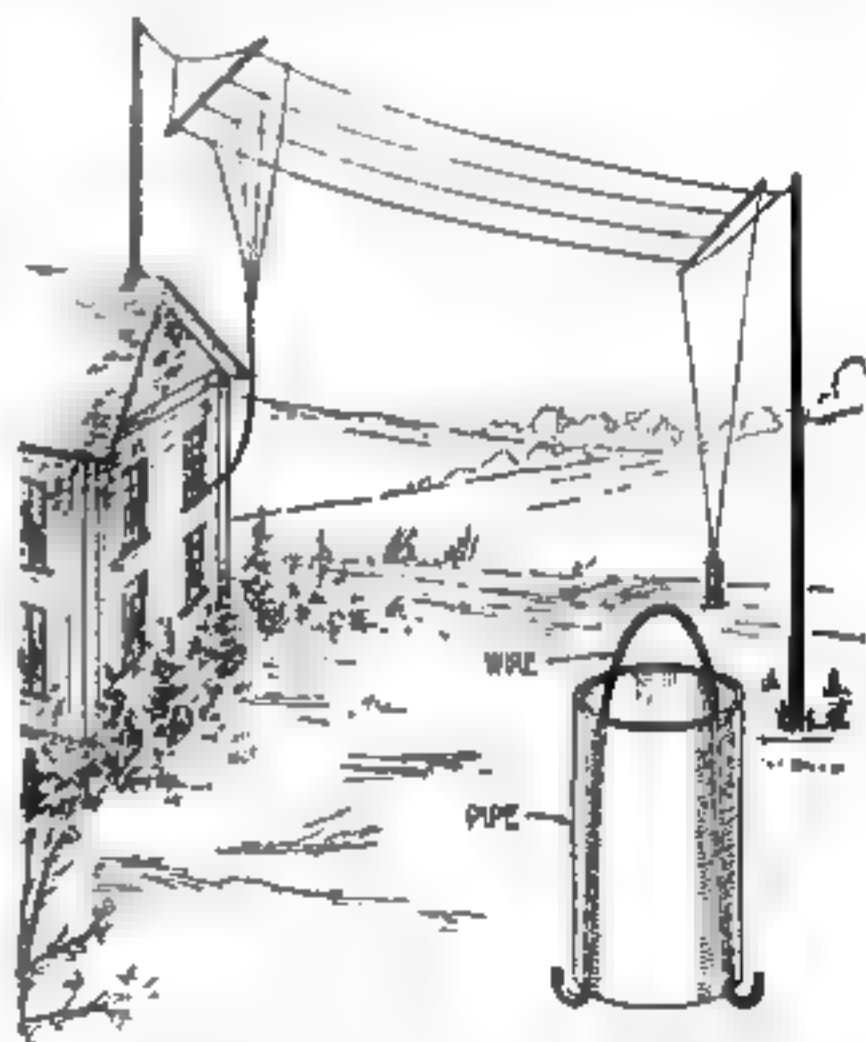
The higher resistance cell is made by winding two wires in parallel, or side by side, on a narrow strip of heavy mica, asbestos board, slate, or other suitable insulating material, as shown in Fig. 7. The edges of this insulating material may be notched before winding, so as to hold the coils in place. Holes should be bored in each end, through which the ends of the wires may pass, so as to secure them. A medium-sized cell is about 1 by 3 in., with the top

side only coated with selenium. It should be wound with copper, brass, silver or platinum wire of about No. 35 gage. The resistance of the cell depends upon its size and the spacing of the wires. It is best to have the wire as warm as possible when winding it on the form, so that as it contracts on cooling, it tightens, thus holding it more rigidly in place. A $1/16$ -in. spacing or less is very often used. The closer the wires, the lower the resistance.

After winding, the selenium is applied in the same way, and the same heat treatment given, as in the construction of the low resistance cell.

Ballast Weights for Antenna to Prevent Aerial from Overturning

TO prevent an aerial from turning over, even though the lower end is not fastened to a mast or tree, the following plan was found effective. Take a piece of 2-in. pipe about 8 in. long and place inside it a piece of wire bent as illustrated. Then fas-



The weight hung to the ends of the spreader to keep the aerial from overturning

ten this with a piece of fine wire so it will hang about 10 ft. below the aerial. Each end of the wire is fastened to the two ends of the spreader. If the pipe alone does not weigh enough fill in with some melted lead or rabbit metal, fastening the wire securely in place.

How I Increased My Earnings From \$2 to \$200 a Day!

*The Remarkable Story of a Young Man's Experience
After Reading a Wonderful Book, as Told by Himself*

SOME people say it takes money to make money—others complain that they never made money because they never had any luck. When one is up against the stern reality of making both ends meet, it is natural to feel that if they only had a little money, or a little luck, they wouldn't have to worry about their bread and butter, and rent, and clothes.

A short time ago I, too, felt that way. I was a bill clerk earning only \$12 a week, and I used to worry myself sick about my future.

To-day—it seems like a dream—all my financial troubles are over—my weekly income instead is about \$1,000—more than I know how to spend. I own two automobiles and have a chauffeur to drive me around. My children go to private schools. I have just purchased, for cash, a \$25,000 home. I go hunting, fishing, motoring, traveling, whenever I care to. I live in a new kind of world.

Let me say in all sincerity that what I have done, I believe any one can do. I am only an average man—not "brilliant"—have never gone to college—my education is limited. I know at least a hundred men who know more than I, who are better educated and better informed—yet not one of them has made as much money as I have, their earnings probably averaging less than \$50 weekly, while my income is over \$1,000 weekly. I mention this to show that earning capacity is not governed by the extent of a man's education—to encourage those who have not had the advantage of a comprehensive education.

What, then, is the secret of my success? Let me tell you how it came about.

One day, about three years ago, something happened that woke me up to what was wrong with me. It was necessary for me to make a decision on a matter which was of little consequence. I knew in my heart what was the right thing to do, but something held me back. I said one thing, then another; I decided one way, then another. I couldn't for the life of me make the decision I knew was right.

I lay awake most of that night thinking about the matter—not because it was of any great importance in itself, but because I was beginning to discover *what was wrong with me*. Along towards dawn I resolved to make an experiment. I decided to cultivate my will power, believing that if I did this I would not hesitate about making decisions—that when I had an idea I would have sufficient confidence in myself to "put it over"—that I would not be afraid of myself or of things or of others. I felt that if I could smash my ideas across I would soon make my presence felt. I knew that heretofore I had always begged for success—had always stood, hat in hand, depending on others to give me the things I desired. In short, I was controlled by the will of others. Henceforth, I determined to have a strong will of my own—to demand and command what I wanted.

With this new purpose in mind I applied myself to finding out something more about will power. The results at first were discouraging. While a good deal had been written about the memory and other faculties of the brain, I could find nothing that offered

any help to me in acquiring the new power that I had hoped might be mine.

But finally I encountered the works of Professor Frank Channing Haddock. To my amazement and delight I discovered that this eminent scientist, whose name ranks with James, Bergson, and Royce, had just completed the most thorough and constructive study of will power ever made. I was astonished to read his statement, "The will is just as susceptible of development as the muscles of the body!" My question was answered! Eagerly I read further—how Dr. Haddock had devoted twenty years to this study—how he had so completely mastered it that he was actually able to set down the very exercises by which any one could develop the will, making it a bigger, stronger force each day, simply through an easy, progressive course of training.

It is almost needless to say that I at once began to practise the exercises formulated by Dr. Haddock, and I need not recount the extraordinary results that I obtained almost from the first day. I have already indicated the success that my developed power of will has made for me.

But it may be thought that my case is exceptional. Let me again assure you that I am but an average man, with no super-developed powers, save that of my own will. And to further prove my contention, let me say that since Prof. Haddock's lessons, rules and exercises have been published, I have come across hundreds of other cases where strengthened will power has brought success and fortune to people who were failures, has enabled thousands to overcome drink and other vices almost overnight—has helped overcome sickness and nervousness, has

transformed unhappy, envious, discontented people into dominating personalities filled with the joy of living.

I have been authorized by the publishers of Prof. Haddock's methods to say that any reader who cares to examine his startling book on will power may do so without sending any money in advance. In other words, if after a week's reading you do not feel that "Power of Will" is worth \$3, the sum asked, return it and you will owe nothing. When you receive your copy for examination you will be interested in the studies on the law of great thinking; How to develop analytical power; How to guard against errors in thought; How to drive from the mind unwholesome thoughts; How to develop fearlessness; How to use the mind in sickness; How to acquire a dominating personality, hundreds of other similar personal power studies.

It is interesting to note that among the 200,000 owners of "Power of Will" are such prominent men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, ex-U. S. Chinese Ambassador; Lieut.-Gov. McKelvie of Nebraska; Assistant Postmaster-General Britt; General Manager Christeson, of Wells Fargo Express Co.; E. St. Elmo Lewis; Governor Arthur Capper of Kansas, and thousands of others.

As a first step in will training, I would suggest immediate action in this matter before you. It is not even necessary to write a letter. Use the blank form below, if you prefer, addressing it to the Pelton Publishing Company, 14-T Wilcox Block, Meriden, Conn., and the book will come by return mail. This one act may mean the turning point of your life, as it has meant to me and to so many others.

PELTON PUBLISHING COMPANY, 14-T Wilcox Block, Meriden, Conn.

I will examine a copy of "Power of Will" at your risk. I agree to remit \$3 or return the book in 5 days.

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Elmwood and Hertel Aves.
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The old trick of the Mysterious Spoon

is now harnessed and earning millions for
owners of burnable property

Did you ever see a "Magic Teaspoon"?

Years ago the Magic Teaspoon trick was one of the best practical jokes at Christmas parties.

It was a solid metal teaspoon, to all appearances just like any other spoon until you used it; but immediately it was placed in a cup of hot tea or coffee—presto! it slipped down into the cup and vanished!

You found only a nugget of soft gray metal in the bottom of the cup.

The trick-spoon was made of certain metals mixed together. Separately, each has a high melting-point, but combined in certain proportions they melt at the temperature of moderately hot water, not gradually, as ice does, but "in a flash," the instant the critical temperature is reached.

Scientists can only explain this mysterious trick of metals by imagining what takes place among the molecules the moment the critical temperature is reached.

An alloy of this type is used in every

Grinnell Automatic Sprinkler-head which you see along the ceiling-pipes of a sprinkler system. It acts as a solder, uniting firmly the metal parts of the strut or brace which keeps the valve of the head securely sealed.

At all ordinary temperatures this alloy is solid and capable of resisting any water-pressure in the Grinnell pipes, or even a severe blow.

RELEASING THE TRIGGER

But mark the instant change that takes place on the outbreak of a fire: No sooner does the heat reach 155° than snap goes the strut like the releasing of a trigger, except that the parts of the "trigger" fly out into the room. Instantly a drenching spray from the Grinnell-head descends on the fire.

Flames are not required; the mere upward rush of heated air is sufficient to open the head.

Water-pressure has no effect until the strut has fused, therefore premature operation is impossible. If a hundred years should elapse before the need arose, this little device would stay on duty day and night, resisting corrosion, pressure or the most persistent water-hammer. But the moment the emergency occurred—"snap"—and the drenching shower would come into action without a moment's hesitation, just as it would today or any other day in the interim.

Scientific explanation is not needed to emphasize the *fact* that every year fires by the hundred are put out by Grinnell Automatic Systems.

For thirty years they have maintained a record for stopping fires before serious damage has occurred.

In spite of the fact that the majority of Grinnell Sprinkler installations are in the most dangerous buildings in the country, where fires start frequently in bins, cupboards, under counters and among piled-up goods, the average loss per fire has been less than \$275.

PREMIUM SAVING, 40% to 90%.

No matter how safe your building *seems*, a fire may occur any day. Your insurance rate is a conclusive index of your danger from fire. The mere fact that a Grinnell installation reduces your premiums 40 to 90 per cent. is ample proof of its protective value.

Grinnells will therefore save you a good part of their own cost each year. In fact, if you don't put them in, you will find a few short years from now you have paid for your Grinnell System in high premiums without having the protection meanwhile for your going business.

Why not get what you are right now paying for?

Any owner of a Grinnell System will urge you to "guard your going business."

Any man who ever had a bad fire in his own thriving enterprise will tell you to beware of taking chances.

Any official in a fire department will warn you against putting your faith in any safeguard that does not reduce your insurance rate from a third to a tenth of what you now pay.

An architect or insurance official will tell you fireproof walls will not save the business going on within them, as is proved by the insurance rate on the contents of "fireproof" buildings.

If your working-capital is tied up, we shall be glad to give you the names of reputable concerns that will accept insurance savings as part of deferred payments on a Grinnell System. Frequently the savings will pay off the entire cost in a few years.

Don't theorize about how little you could save, but get the *facts*.

Ask your stenographer to write to-day to the General Fire Extinguisher Co., 290 West Exchange St., Providence, R. I., for a Grinnell Information Blank.



GRINNELL
AUTOMATIC SPRINKLER SYSTEM
The Factory-Assembled System



The standing position. Stand at right angles to the firing line, pointing across the body to the left.



The kneeling position. Point your right knee directly to the right, along the firing line.



The prone shooting position. Lie flat at an angle of 45 degrees to the firing line.



Winchester Medals for skill with the rifle

The Gold-Plated "Sharpshooter" Medal goes to the boy or girl under 18 who makes the first grade score with a Winchester .22 rifle and Winchester ammunition.

The Silver-Plated "Marksmen" Medal goes to the boy or girl who makes the second grade score.



Three correct positions for earning the "Sharpshooter" Medal

Every real boy wants a Winchester rifle. He wants it for its own sake and because it will give him a chance to compete for the famous silver-plated "Marksmen" and gold-plated "Sharpshooter" medals offered by the Winchester Junior Rifle Corps.

Your boy is no exception. He wants a Winchester and he wants it now. He is fairly aching to get in on the "Marksmen" and "Sharpshooter" medal contests because he sees many of his friends sporting the handsome medals themselves.

He doesn't want to be outdone. You can't blame him.

A competition for real boys

The Winchester Junior Rifle Corps is an organization with an honorary membership among boys

who have earned their "Marksmen" and "Sharpshooter" medals. Every one of the members has a diploma signed by the President of the Winchester Repeating Arms Company certifying his standing in the organization.

The fun you can have with a Winchester .22

You want your boy in the Winchester Junior Rifle Corps. His "Sharpshooter" medal will be a source of as much pride to you as to him. It will stamp him as a boy of character and ability, a good citizen of the future. Both you and he can have a lot of fun with the beautiful Winchester .22 while you are teaching him how to hold and fire it in the three correct positions.

There is a place near you, either in the open or at a club, where you

can shoot. If you do not know where to shoot, write to us, and we will tell you where you can, or we will help you to organize a club.

Let the boy have it now

Chances are your boy has already picked out the Winchester he wants at your dealer's store. Take him there today and get it for him. You will be surprised to find what a fine gun you can get for a low price. The dealer will explain all the rules of the Winchester Junior Rifle Corps Contest, furnish the targets and see that the boy gets the medals and diplomas when he has made the winning scores.

WINCHESTER REPEATING ARMS CO.

Dept. 52

New Haven, Conn.



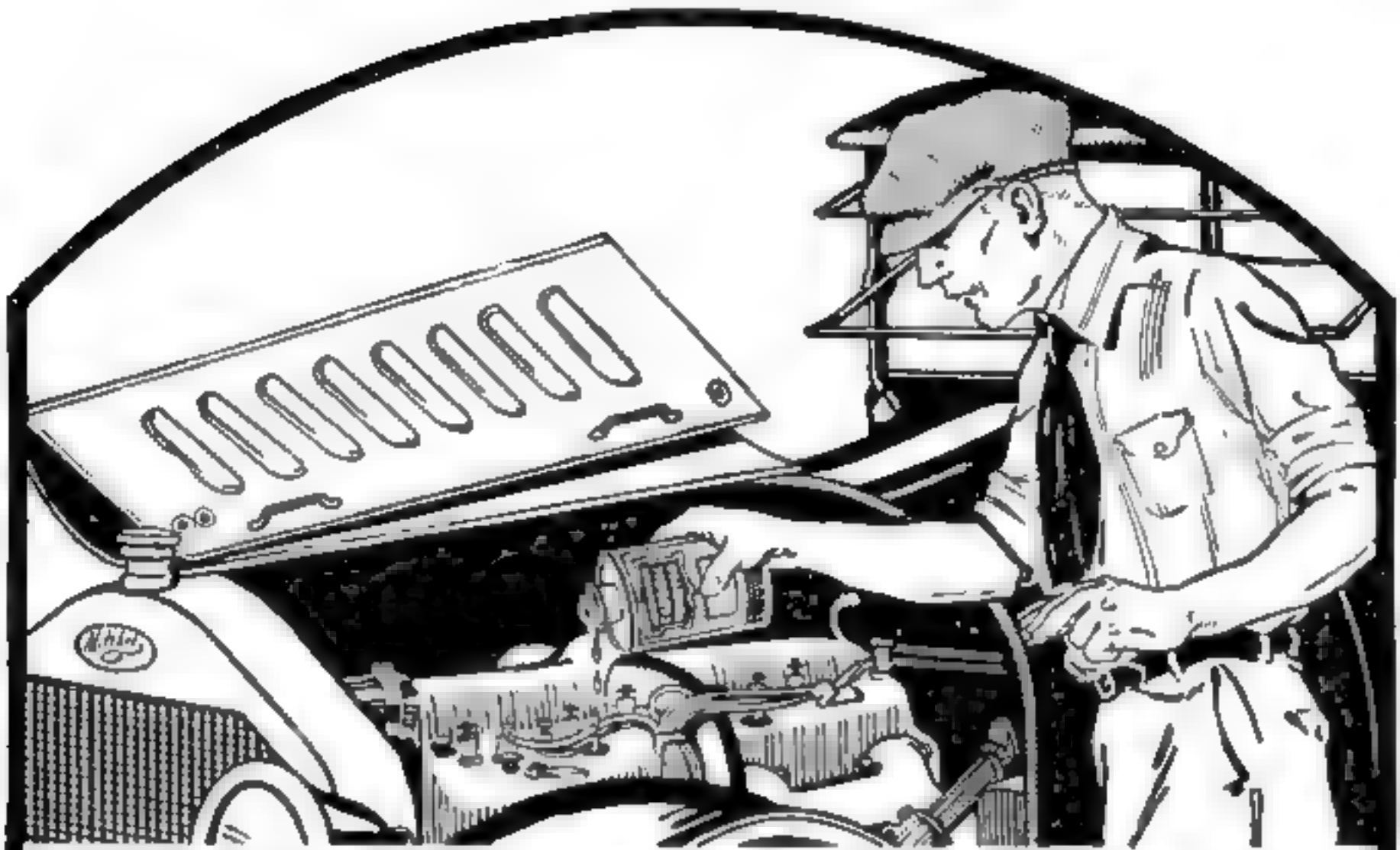
MODEL 24 Take-down Repeating .22 caliber rifle, 20-inch round barrel. Shoots three sizes ammunition. The most popular .22 caliber repeater ever placed on the market.

Take-down .22 caliber single shot rifle. A low priced, light weight gun made in two sizes.

WINCHESTER

World Standard Guns and Ammunition

When writing to Advertisers please mention Popular Science Monthly



Put New Life In Your Engine

A DOSE of Johnson's Carbon Remover—the engine laxative—will increase the power of your car—improve acceleration—stop that knocking sound—quiet your motor—save your batteries—and reduce your gasoline consumption from 12% to 25%.

JOHNSON'S CARBON REMOVER

Is a harmless liquid to be poured into the cylinders. It softens the carbon and releases it from the metal. It then burns, powders and is blown out through the exhaust. Five minutes' time and no labor required. You will save from \$3.00 to \$5.00 over any other method, without loss of time and with very much better results.

If you will use Johnson's Guaranteed Carbon Remover every 1,000 miles you can keep your motor clean and sweet and always at its highest efficiency and you will secure the maximum power and speed from the minimum amount of fuel.

Special Offer

If your dealer cannot supply you with Johnson's Carbon Remover use attached coupon. For a limited time we will include gratis, a half-pint sample of Johnson's Stop-Squeak Oil—our new product. It instantly penetrates between the leaves of springs thoroughly lubricating them and giving perfect spring action.

S. C. JOHNSON & SON, Dept. PSM 11, Racine, Wis.

I enclose \$1.00 for which please send me, prepaid, enough Johnson's Guaranteed Carbon Remover to thoroughly clean an ordinary four-cylinder motor three times. Also send half-pint of Johnson's Stop-Squeak Oil free.

Address

City and State

My Dealer is

EVEREADY DAYLO



The light that says
"There it is!"

RUNNING in from an advanced post, at night, Longshaw R. Point, of the American Ambulance Field Service, with two wounded men in his car, traveled a road that was less than a kilometer distant and in full view of the enemy lines.

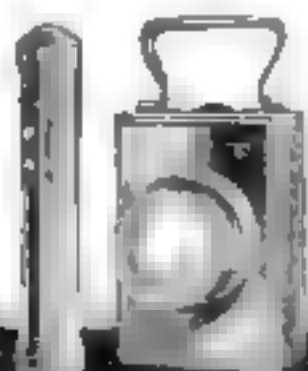
Suddenly the engine stopped dead. To light a match would have revealed his position, with the result that at any instant a shell might sweep across the road and wipe the car and its two wounded occupants off the map!

But he had his Daylo with him, and, holding his hand as a shade, was able to throw light all over the engine without revealing his position. In a minute he located the trouble, in three minutes there was no way to the hospital. Safe! For ever, emergency of the night, Daylo is ready, dependable.

77 different styles at prices from 75 cents up. In Canada 85 cents and up. Such is the power of electrical hardware, that, apart from its uses in industry and jewelry stores, everywhere.

Daylo is a reliable light for camp, work, or home. Eveready Daylo is the best light you can get.

AMERICAN EVER READY WORKS
of National Carbon Co., Inc.
LONG ISLAND CITY NEW YORK
Chicago Atlanta San Francisco
Canadian National Co. Ltd.
Toronto, Ontario



when all other
lights fail

when the motor
stalls and the
trouble must be
located instantly

when you're look-
ing for something
in that dark cor-
ner of the attic

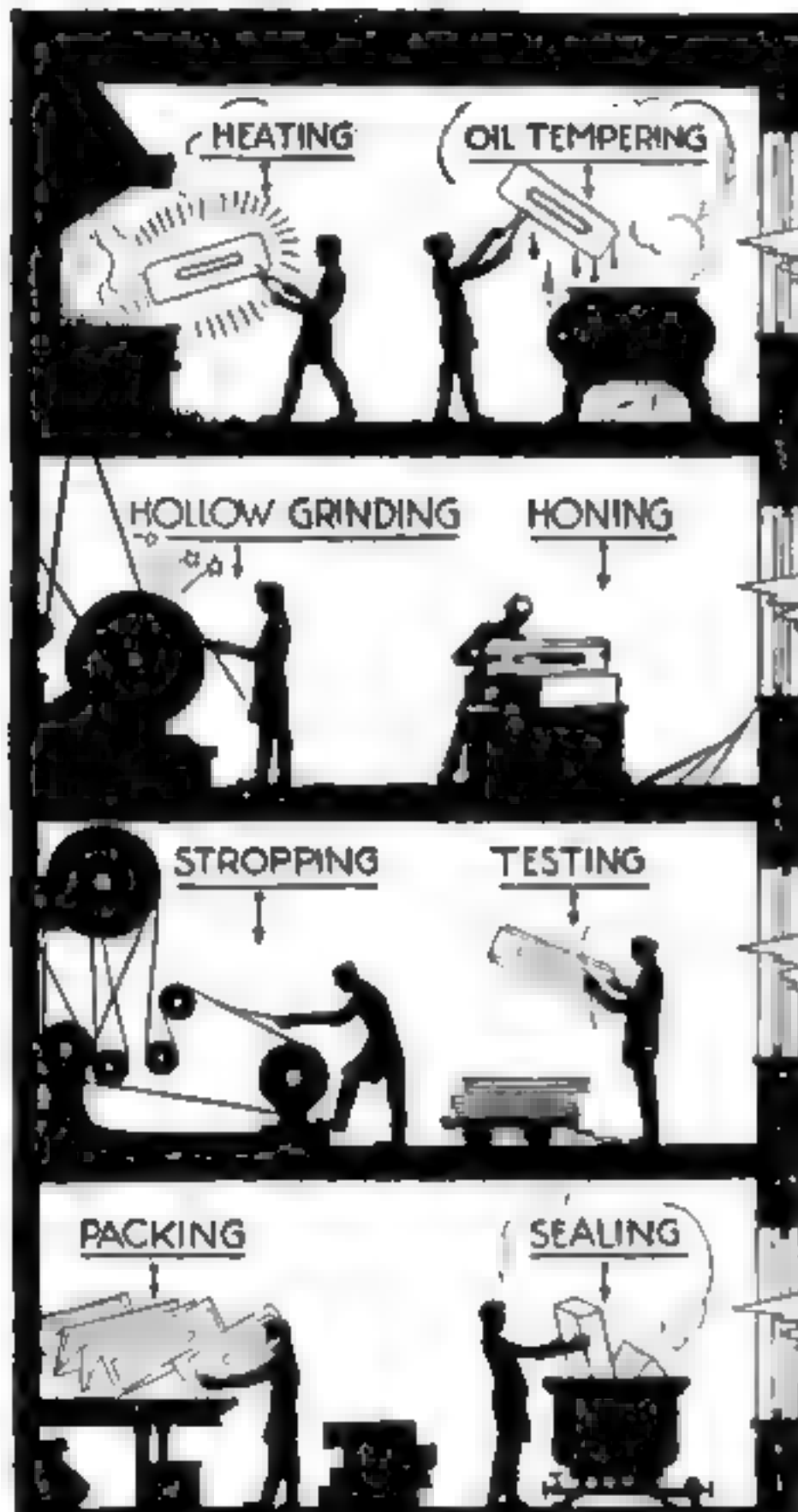
when a fire flows
and as the night
goes on

when you can't see
to read a map, post
or letter

whenever you need any
kind of light,
get an Eveready Daylo.

Don't ask for a flashlight—get an Eveready DAYLO

The great American mechanic and the **DURHAM-DUPLEX** Blade



The American mechanic speaks:

"You ask me why Durham-Duplex blades stay sharp longer than other razor blades. They're harder and they're oil-tempered—that's the reason. Hardness is secured by heating the steel and then quenching it in water. Everybody knows that. But I know exactly to what degree the steel should be heated. I know how long it should remain in the oven before it is quenched. And I know just what kind of oil to use for tempering. These are my secrets."

"Why are Durham-Duplex blades keener than other blades? I can tell you that, too. It's the way they're hollow-ground and honed. These operations require great skill and long experience. I know how much of the steel to grind away. I can measure this grinding accurately—to a ten-thousandth of an inch. I know just how the blade should be honed to get the super-keen edge you require."

"Then comes the important detail of stropping. I have invented a machine that takes care of this operation better than I could. Every Durham-Duplex blade is stropped on 2700 inches of leather—equal to 450 six-inch strokes. I watch that machine closely and inspect every blade. I won't pass a blade along to the packing room if it isn't 100% perfect. To make sure I cut a hair six times with every blade."

"All my pains in producing a masterpiece would be wasted if I let the blade go out any old way. So I invented a special container for Durham-Duplex blades. When the blade is packed, I seal the package hermetically in melted paraffine. Then I don't care if you throw the package against a stone wall—you simply can't spoil my work. The super-keen edge is bound to get to your face just as it left my hands."

The Durham-Duplex mechanic is proud of his work. You will understand why when you try his blade. Invest \$1 today in a \$5 Durham-Duplex Domino Razor Set, containing a package of three of the famous Durham-Duplex double-edged blades. Get it from your

dealer or from us direct.

Address Dep't T37

DURHAM-DUPLEX RAZOR CO.

190 Baldwin Avenue, Jersey City, U. S. A.

CANADA
43 Victoria St.
Toronto, Ont.

ENGLAND
27 Church St.
Sheffield

FRANCE
56, Rue de Paradis
Paris



The scars left by hot dishes

and moisture stains that mar the table top are things unknown to thousands of housewives. They use table mats and pads of

JOHNS-MANVILLE

Asbestos

Resistant to heat,



water, wear and weather

Practically unknown for ages, this mineral is today, through Johns-Manville, available in every conceivable form. On factory piping it conserves heat — on electric wires in your home it spells safety.

COVERS
THE CONTINENT

The theatre curtain, the moving-picture booth, the brake lining on your motor car—all depend on J-M Asbestos. The history of Johns-Manville is read in the growth of Asbestos as a world-wide utility.

H. W. JOHNS-MANVILLE COMPANY
New York City

10 Factories—Branches in 54 Large Cities

Asbestos Fabrics, Packings, Roofings, Shingles, Brake Linings, Building Materials, Electrical Devices, Heat Insulations, Refractory Cements, Waterproofing.

The Motor Car



The Farm



The Home



Industry



Power Plants



Transportation



Roofings



**When you think of Asbestos you think of
Johns-Manville**

Lord Elgin ~

-another beautiful streamline

\$75-
In Solid Gold**



The \$75 Streamline is complete in Solid Gold case and individual presentation box. The movement is the famous Lord Elgin model extra thin with 19 Jewels and 8 Adjustments * * * The same watch in 14 Karat Gold Filled, complete at \$55 * * * *

The Streamline Series of Watches

has brought the Elgin Company into the limelight as designers of complete watches.

Lord Elgin, the third of the series, is one of the finest and most distinguished of the Streamline models.

It is extra thin.

The "close up" view at the left shows somewhat of its distinctive personality — every inch a gentleman's timepiece.

Your Jeweler will enjoy showing you this new \$75 Streamline, as well as the \$25 and \$50 Streamlines previously announced — also Elgin Bracelet Watches for women. Illustrated folders on request.



ELGIN NATIONAL WATCH CO., ELGIN, U.S.A.
Designers and Producers

When writing to Advertisers please mention Popular Science Monthly



HOME DEFENCE

Right now, when defence is the issue of the hour, is the time for every man to settle the question of *complete* defence of his home. It's a man's *duty* to defend his loved ones from the aggression of prowling burglars.



A *friendly* Iver Johnson Revolver should be in every home just for the peace of mind and mental comfort it gives. It is the safest small arm that you can own. You can drop it, throw it against a wall, or "Hammer the Hammer"—the cartridge will *not* explode. Only one thing under the sun can make it go off—a pull on the trigger.

Hammer model with Regular Grip, \$8.00. Hammerless model with Regular Grip, \$8.75. "Perfect" Rubber and "Western" Walnut Grip, extra.

Three Books FREE

Indicate which books you want: A—"Firearms"
B—"Bicycles," C—"Motorcycles."

IVER JOHNSON'S ARMS & CYCLE WORKS

143 River Street, Fitchburg, Mass.

99 Chambers St., New York 717 Market St., San Francisco



Iver Johnson "Western" Walnut Grip Revolver with 5-inch barrel shown here is a real man's gun. It has perfect accuracy and is a dead shot. Accidental discharge impossible. \$10.00.

When writing to Advertisers please mention Popular Science Monthly

LOOK ON THE TOP WAD FOR "INFALLIBLE" OR "E. C."

HERCULES

Smokeless Shotgun

POWDERS

Peters

HIGH GUN
IDEAL
PREMIER
TARGET

Remington
UMC

ARROW
NITRO CLUB

SELBY LOADS

CHALLENGE
SUPERIOR

US BLACK SHELLS

AJAX
CLIMAX

Western

FIELD
RECORD

WINCHESTER

REPEATER
LEADER

When you buy loaded shotgun shells you buy by name. You ask for your favorite make and see to it that you get it.

But if this is all you do you omit an important detail. You overlook the matter of powder.

It is just as easy to obtain a powder with which you are familiar, a powder in which you have full confidence, as it is to obtain your favorite make of shell. You ask for the powder by name just as you ask for the shell.

Hercules Smokeless Shotgun Powders, Infallible and "E.C.", may be obtained in the standard makes of shells given at the left. The shell you shoot is among them. You can obtain a Hercules powder in that shell by asking for it when you buy.

On the top wad of every shell, and on the side of the box in which the shells are sold, is printed the name of the powder with which the shell is loaded. Look for the name when buying. See that it is either Infallible or "E. C."

These powders are of high quality and uniform quality. They give light recoil, even patterns, and high velocity. Write for a free booklet which describes them fully.



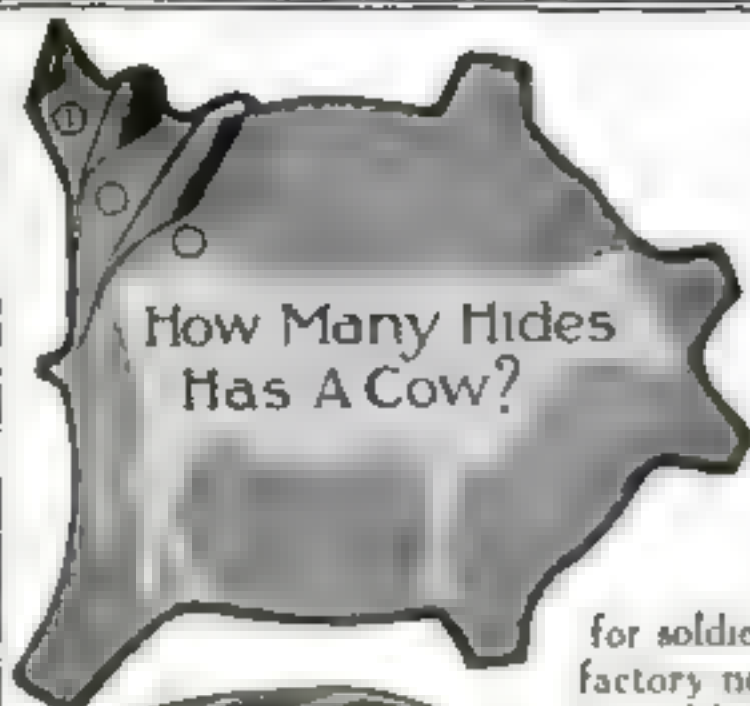
HERCULES POWDER CO.

1841 Market Street

Wilmington

Delaware

IIIIII★DU PONT AMERICAN INDUSTRIES★IIIIII



How Many Hides
Has A Cow?

Uncle Sam Knows the Real Answer:

NOT ENOUGH! SAVE LEATHER For Soldiers

TO make America's hide supply go as far as possible, hides are being split into five or more thin sheets; but, even this saving scheme fails to meet the requirements for soldiers' shoes, harness, equipment, ship upholstery, factory needs, etc., chiefly because too much hide leather is used by the public in places where high grade leather substitutes will serve as well or better.

Uncle Sam Has Set the Pace

The new U. S. motor trucks and ambulances will be upholstered in leather substitutes. For several years the standard for book binding in the Government Printery has been Du Pont Fabrikoid.

The upholstery specifications for the new Merchant Marine call for



REG. U. S. PAT. OFF.

Craftsman Quality

What Uncle Sam has found by experience and tests good enough for the Government's severe requirements should be good enough for every loyal American.

How You Can Help

If you are a manufacturer using leather probably part or all of your requirements can be met by some grade of Fabrikoid. While not feasible for every use of leather, the illustrations herewith show its wide range of utility.

If you use leather in your home for any purpose, try the proper grade of Fabrikoid instead.

When buying an automobile, boat or piece of furniture prefer Fabrikoid upholstery. Help the manufacturer conserve leather by patronizing those who use good leather substitutes like Fabrikoid.

Every hide displaced by a good substitute helps supply our armies with shoes, our farms with harness and our factories with belting—it helps win the war.

Manufacturers! write us your requirements and let us co-operate with you.

Americans everywhere! write for samples and names of manufacturers of the article you want, who use Fabrikoid and of stores near you selling it by the yard.

DU PONT FABRIKOID CO. Wilmington, Del.

World's Largest Manufacturers of Leather Substitutes

Factories at

Newburgh, N. Y.; Elizabeth, N. J.; Fairfield, Conn.; Toronto, Ont.



For
Automobile
Seats and
Upholstery



For Boat
Seats and
Upholstery



For Furniture
Upholstery



For Bags,
Trunks and
Suitcases



For Book
Binding



For Home
Decorations,
Novelties,
Belts, etc.

DU PONT

MARMON 34

Bodies for Marmon 34 closed cars are custom built by American coachbuilders. The new type of sedan seats seven in perfect comfort. Every line makes the car distinctive. Advanced engineering makes it quiet, light, perfectly balanced, economical of tires and fuel.

136-inch wheelbase; 74 brake-horsepower; 1100 pounds lighter.

**NORDYKE & MARMON
COMPANY**
Indianapolis, U. S. A.



One of Forty Handsome Watches

HERE is one of the latest shapes and styles in South Bend watches. A new *Extra-Thin* Chesterfield that is winning quick favor among men who appreciate distinction in design as well as accuracy in time-keeping.

It's a watch you will be proud to own and show. But you are not limited in your choice to anyone model when you choose a South Bend Watch.

There are more than forty different combinations of movements, dials and cases to select from, making it certain that you can find a South Bend Watch to suit your tastes and express your own individuality.

Prices range from \$16.00 to \$125.00.

See the Watches at your jeweler's or write for "A Book of Good Watches"

SOUTH BEND WATCH CO.

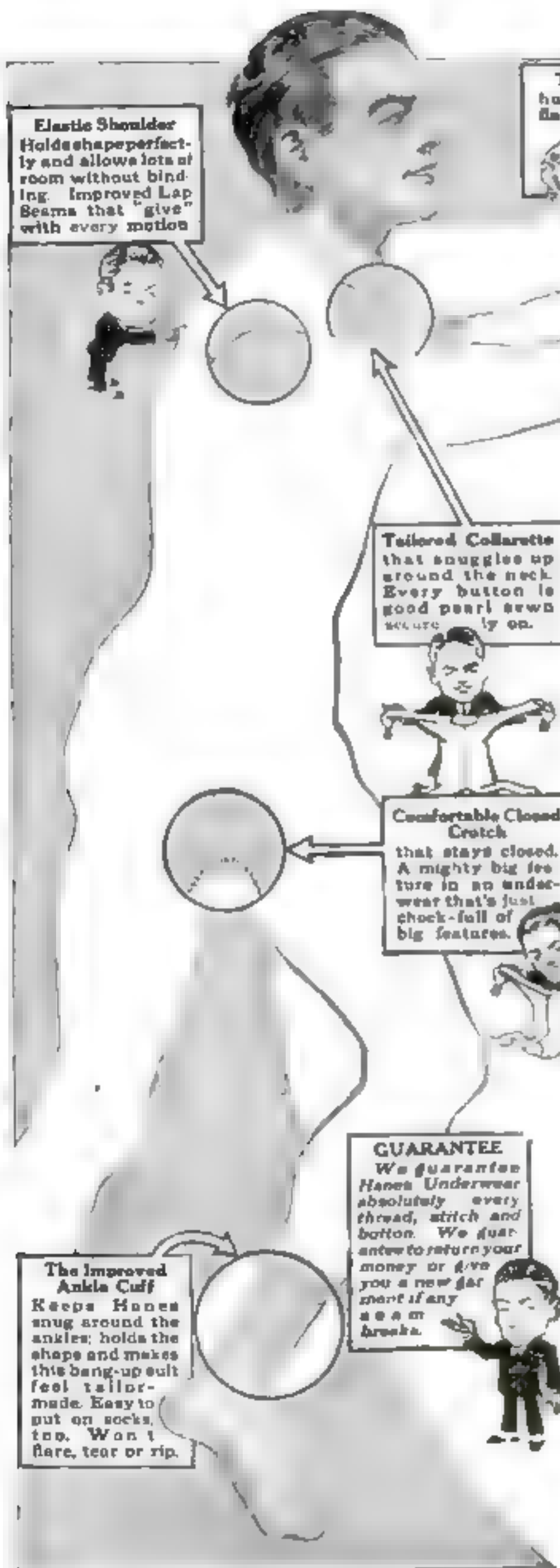
For years, makers of standard railroad watches

211 Studebaker Street
South Bend, Indiana



South Bend

The Watch with the Purple Ribbon



Elastic Shoulder
Holds shape perfectly and allows lots of room without binding. Improved Lap Seams that "give" with every motion.

The Improved Cuffs
hug the wrist and won't flare out. Special stitching prevents ripping where they join the garment.

Tailored Collar
that snuggles up around the neck. Every button is good pearl sewn securely on.

Comfortable Closed Crotch
that stays closed. A mighty big feature in an underwear that's just chock-full of big features.

GUARANTEE
We guarantee Hanes Underwear absolutely every thread, stitch and button. We guarantee to return your money or give you a new garment if any see a m break.

The Improved Ankle Cuff
Keeps Hanes snug around the ankles; holds the shape and makes this bang-up suit feel tailor-made. Easy to put on socks, too. Won't flare, tear or rip.

Why Not Save That Extra on Underwear?

With prices racing sky-high on 'most everything, it's a mighty good feeling to know you can get the finest sort of wear, warmth and comfort in winter weight underwear and at such popular prices.

It's really a startling eye-opener to see just what amazing value you can get. Read about the extra features over there in the illustration. Add 'em all up—then get this:

Hanes Winter Weight Underwear is made of fine, long-fibre cotton, snug-fitting, slightly and strongly made. Every seam is guaranteed unbreakable where the wear is greatest. It is springy and comfortable, warm and cozy. Built strong—washing can't faze it.

Greatest
Winter
Underwear

HANES

Sold at
Popular
Prices

ELASTIC KNIT UNDERWEAR

Where can you get anything to touch that for downright value? Don't pay a high price just because you're used to paying it. Hanes is good enough for any man.

If you're paying less, add a little and get extra wear, feel and value. You'll be mighty glad of it when you warm up to this splendid underwear.

Here's the Big Specialty for 1917

A boy's union suit, superbly made with an unusual silky finish. A real high-class boys' underwear that combines the best features of the men's suits with a downy softness and cozy warmth just right for youngsters. Its value can't be duplicated anywhere.

Ask the Hanes dealer to let you see these two big underwear values. If you don't know him, write us. Don't let this chance slip by but stock up against the cold weather by buying a half dozen suits before your dealer is sold out.

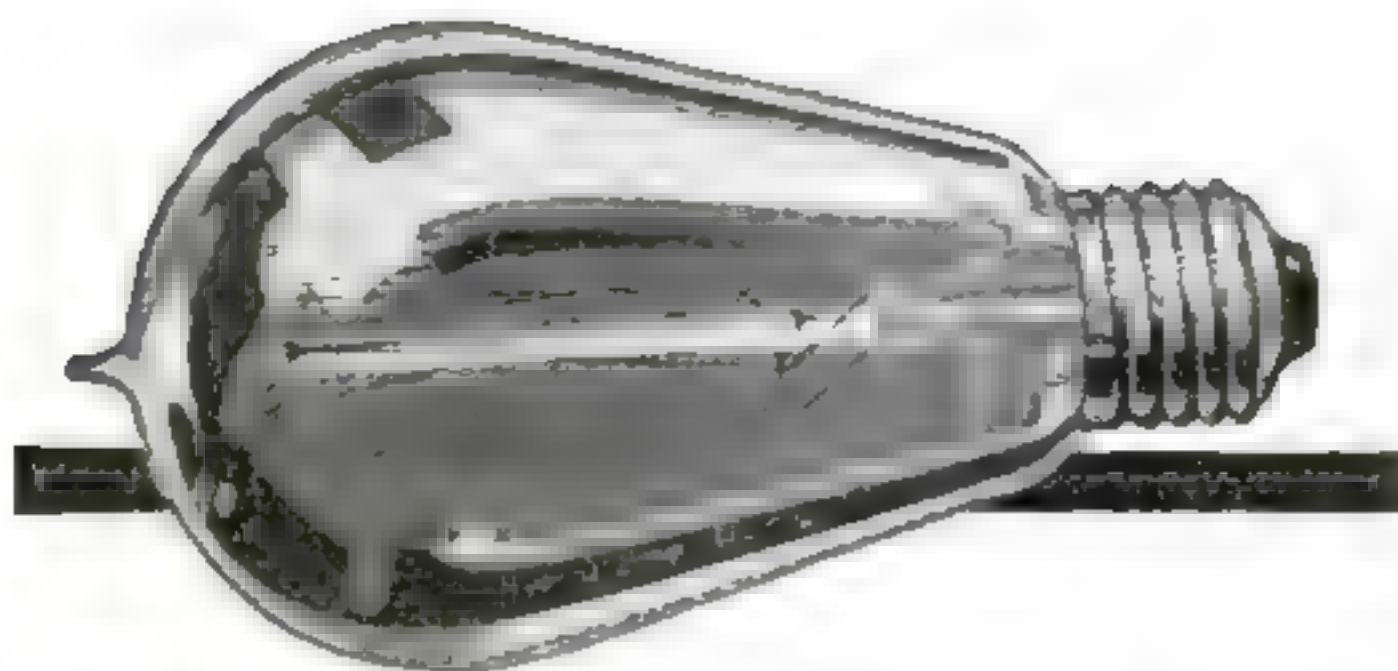
P. H. HANES KNITTING CO.
Winston-Salem, N. C.

Warning to the Trade—Any garment offered as Hanes is a substitute unless it bears the "Hanes" label.

This Label on Every Garment



Buy Hanes Without It



MAZDA

"Not the name of a thing, but the mark of a service"

MAZDA Service—a systematic research for making good lamps better

The Meaning of MAZDA

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this Service. MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady.

The mark MAZDA can appear only on lamps which meet the standards of MAZDA Service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.



RESEARCH LABORATORIES OF
GENERAL ELECTRIC COMPANY

"You simply can't whip
your nerves like that!"



PUSHED to the wall by our wavering nerves, some of us turn to stimulants for aid, or to treacherous bracers or pick-me-ups. These revivify for the moment but exact a heavy toll for the temporary lift they give.

Not the goading help of a stimulant, but the lasting help of a scientifically devised builder, a natural builder *that actually adds to the very cells and tissues*—this is the help your weary nerves need. And this, to judge from the voluntary testimony of thousands of physicians, is exactly what Sanatogen offers.

As Richard Le Gallienne, the writer, himself a grateful user of Sanatogen, says, "Sanatogen is no get-well-quick remedy. It professes no dishonest possibilities with nature.

It does not lift you up one moment, to leave you in the lurch the next. But *what it does it does for good!*"

Give your nerves the constructive help they need to-day. Let Sanatogen help restore their balance, bringing better appetite, better digestion and more restful sleep.

Sanatogen is sold by good druggists everywhere, in three sizes, \$1.00 and up. Awarded the Grand Prize at the International Congress of Medicine, London, 1913.



Send for "The Art of Living"—a charming little book by Richard LeGallienne, the popular, poet-author touching on Sanatogen's kindly help and giving other interesting aids in the quest for contentment and better health. This book is free—address The Bauer Chemical Co., Inc., 372 Irving Place, New York.

Sanatogen
ENDORSED BY OVER 21,000 PHYSICIANS

When writing to Advertisers please mention Popular Science Monthly

Here's Grinnell's Famous "One-Fingered" Mitten

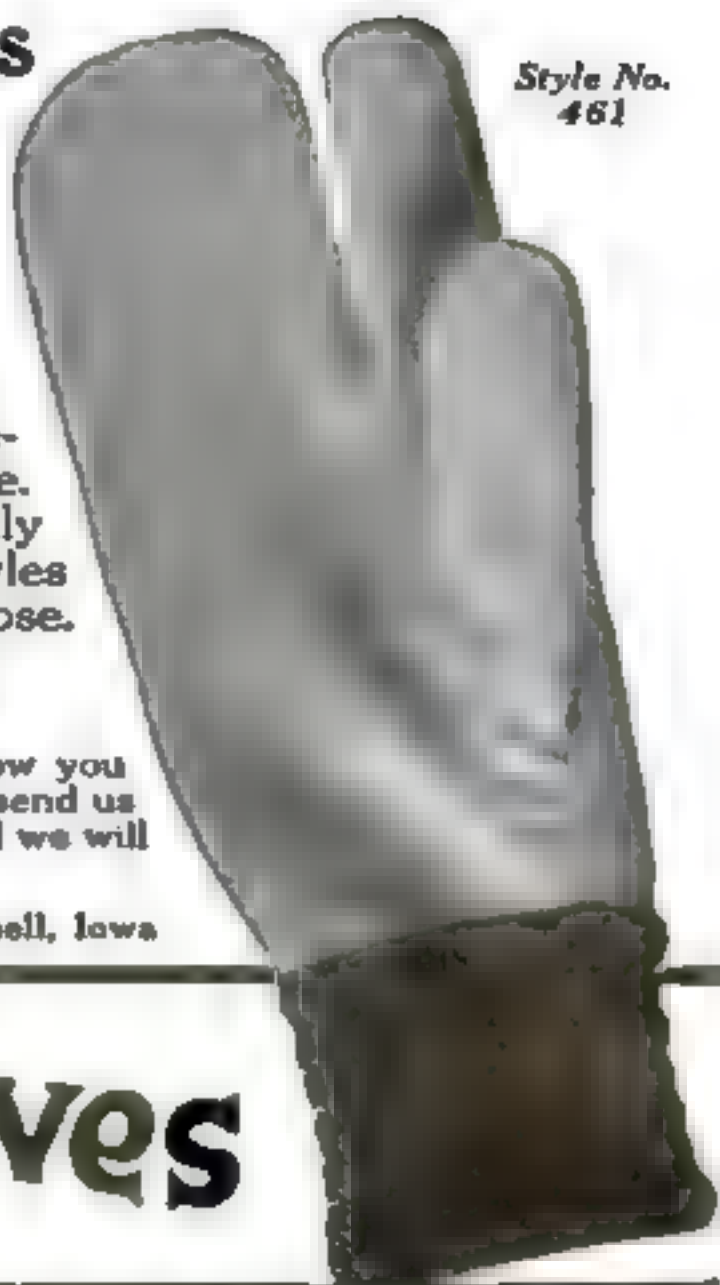
Our "One-Fingered" Mitten has made many thousands of friends among outdoor men everywhere. Gives perfect hand-protection, and free use of trigger finger.

It's made of velvet coltskin, strong, serviceable, washable in soap and water or gasoline. Warm linings. The wrist is protected from chilly blasts by an elastic web top. There are 600 styles of Grinnell Gloves—for every conceivable purpose.

Despite the world-wide leather shortage, we maintain the famous Grinnell quality. Insist on genuine Grinnells.

Glove Book Write for it today. Ask your dealer to show you the "One-Fingered" Mitten. If he hasn't it, send us **FREE** his name, state size of glove you wear and we will send you a pair on approval—charges prepaid.

MORRISON-RICKER MFG. CO., 142 Broad Street, Grinnell, Iowa



Grinnell-Gloves

Best for Every Purpose

The points of a master pencil



The lead, in the softer grades, is responsive and even in tone. It will not crumble. In the harder grades it holds a fine point and requires less frequent sharpening. Free from grit it will not scratch the paper.



The case is straight grained, knifless cedar that is strong enough to keep the lead from breaking under rough treatment, but soft enough to be easily sharpened.



**DIXON'S
ELDORADO**

"the master drawing pencil"

is the name that stands for perfection in pencils. Used by engineers and artists whose every tool is chosen with the most scrupulous care.



The degrees, 17 in number, are each true to grade. They cover every pencil use. Send 16 cents in stamps for samples worth double the money.

JOSEPH DIXON CRUCIBLE CO.
Department 120-J Jersey City, N. J.

When writing to Advertisers please mention Popular Science Monthly



**WIFIE WON'T KNOW THE OLD BUS
IF YOU PAINT IT UP WITH**

**Effecto
AUTO.
FINISHES**

Your wife will be proud to ride in your little old last year's car if you give it a coat or two of Effecto. Not a wax or polish, but a durable, quick-drying, high-luster auto enamel, made in seven colors.

Sold by paint, hardware and auto accessory dealers. Send for Color Card. Pratt & Lambert Inc., 155 Tonawanda Street, Buffalo, N. Y. In Canada, 101 Courtwright Street, Bridgeburg, Ontario.

**MADE BY THE MAKERS OF
PRATT & LAMBERT VARNISHES**

"Keep Up Sports and Games" says Uncle Sam



Insist on Goods with the Wilson Trade-mark

The Wilson trade-mark on your sporting goods stands for finest quality and latest improvement. It means that your goods are unconditionally guaranteed by a concern backed by \$30,000,000 capital. It means that if Wilson sporting goods do not meet with your complete satisfaction, we will make adjustment that is satisfactory to you.



No. A-5—Here's the Football that the big Universities are using this season. Football coaches say it is the liveliest, most enduring ball made. Patented double lining feature makes the ball hold its shape indefinitely. Stands a lot of punishment. Packed complete. **\$7.00**

No. B-124-BC—This jersey is just what you need for school or sport. You can get it in any one of these stripe combinations: Navy blue with white stripe, black with orange stripe, maroon with white stripe, navy blue with orange stripe, gray with navy blue stripe, royal blue with white stripe. Each... **\$3.00**

No. J-4—This Official Intercollegiate Basketball was adopted for the National A. A. U. Championship. Used and endorsed by practically every university and college in the country. Patented double lining feature makes it outlast any other ball and hold its shape indefinitely. The two impacted dark linings of opposite weave produce an opposite tension which keeps the ball perfectly round. No other basketball has this feature. The most responsive ball you ever played with. Packed complete. **\$10.00**

No. 117—Get these Wilson Boxing Gloves and learn to be an expert in the manly art. Boxing makes you keen of eye, quick and physically strong. These gloves are genuine Salivan pattern with reinforced lacing. Per set of 4 gloves. **\$3.25**

Get this Wilson Library—FREE!

An out-and-out gift to you from Thos. E. Wilson & Co. Books on Tennis, Baseball, Basketball, Fishing, Camping, Golf, Football, each filled from cover to cover with fascinating facts about your favorite games and sports.

Send No Money for Books—Just the Coupon

THOS. E. WILSON & CO.

Dept. P. S. 10 and 14 South Wabash Avenue, Chicago, Ill.

----- **COUPON** -----
THOS. E. WILSON & CO., Chicago, Ill.

Gentlemen—Please send me your free library of books for sports and games. Find enclosed \$ for which please send me articles that are checked.

☐ A-5 Football ☐ J-4 Basketball ☐ Wilson Boxing Gloves
☐ B-124-BC Jersey, size color

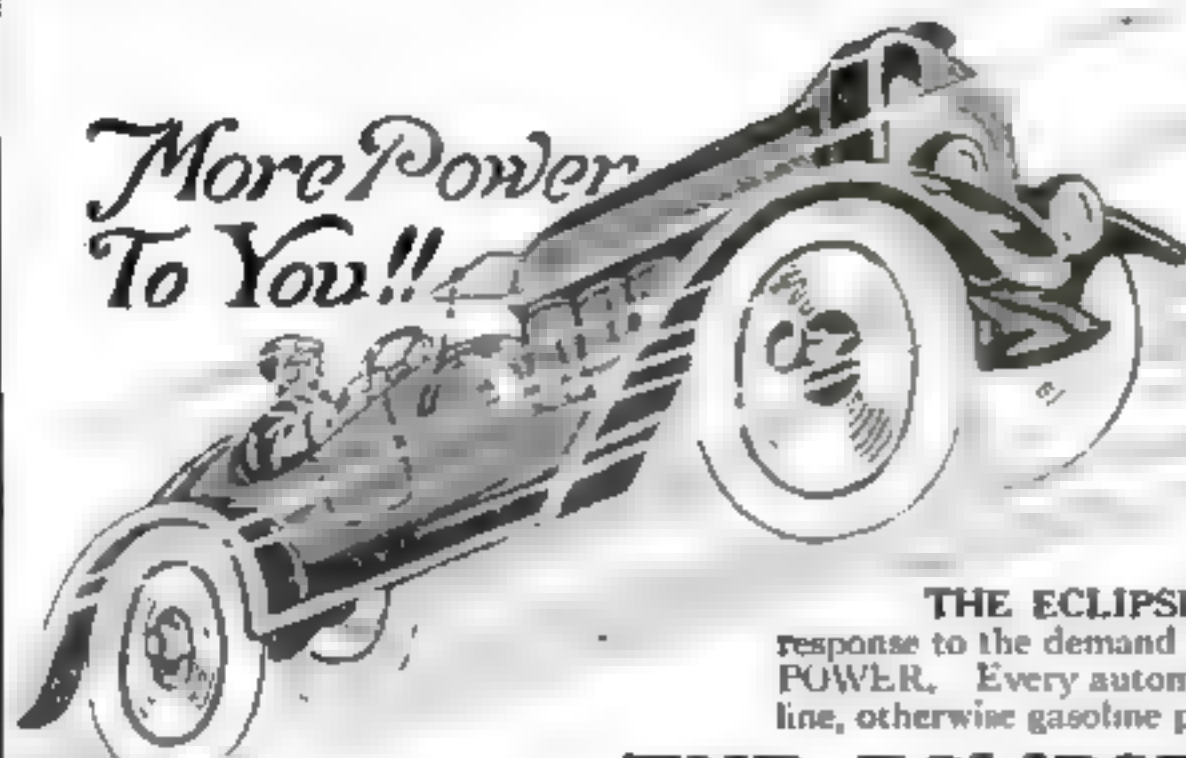
Mr. Dealer, Mr. does not handle Wilson Goods.

Name

Address..... City



More Power To You!!



Makes every 5 gals. of Gasoline yield 5 gals. of Power
—or your MONEY BACK



THE ECLIPSE VAPORIZER
with patented diffusing wheel

and More Mileage from your Gas!

A.C. Bedford, President of the Standard Oil Company, in a recent statement notified the government and the people that the supply of gasoline is limited, and heavy war demands obligate us to be careful in its use.

THE ECLIPSE VAPORIZER is the inventor's response to the demand for CHEAPER and INCREASED POWER. Every automobile owner should conserve gasoline, otherwise gasoline prices are bound to "Sky-rocket."

THE ECLIPSE VAPORIZER Saves 25% Gasoline

Slipped in the intake manifold it diffuses the gasoline globules so that you secure perfect combustion. No burning, no maddening. Saves five gallons out of every twenty of gasoline. Makes your car a higher powered machine—prevents excessive formation of carbon. Our guarantee is backed by the fact that we are the successful manufacturers of such well known devices as ECLIPSE BENDIX DRIVE, used on 150 different standard automobiles. ECLIPSE CLUTCHES, HUBS and BRAKES, and MORROW COASTER BRAKES.

Start saving gasoline money. Send \$3.50 for an ECLIPSE VAPORIZER on 60-day trial offer with money-back guarantee.

Give name and year of car with size carburetor. Write name and address plainly on margin of ad. Tear out and mail.

ECLIPSE MACHINE CO., Dept. C, Elmira, N.Y. Write for Agency Offer

Stop that Squeak!

In the springs of your car with

HOMOL

TRADE MARK

It polishes the metal, the glass and the body. It prevents rust.

Made for sportsmen by sportsmen, Homol is the "best" ever for car repairs, car body work and camp. A solution for all your car troubles.

If you don't know what Homol is, send us his name and address and we will send you this big five-ounce can, carriage prepaid.

William Peterman, Inc., 200 Fifth Ave., New York City



Unscrew the cap and out springs the spout ready for use. Screw on the cap and in goes the spout, away from dust and dirt.



Do your own Plumbing or Heating Our New EASY WAY Buy From Us Direct—Save 1/2



Send for Our Big Valuable "Handy-Man" Book

Shows how to install and repair
all the plumbing and heating
fixtures in your home. Includes
instructions for installing
STEAM, HOT WATER or HOT
AIR HEATING PLANTS, or
any other system.

"Our New Hardin Easy Way"

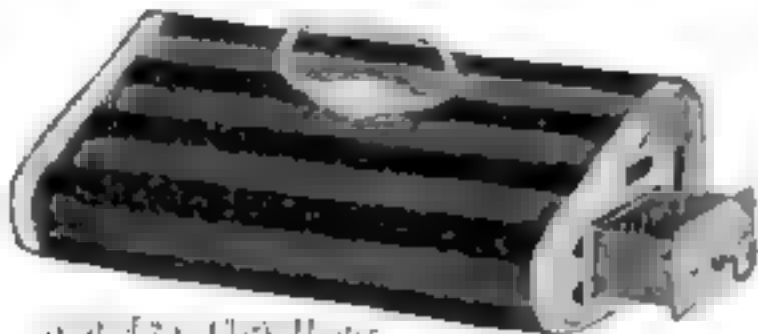
Shows how to install and repair
all the plumbing and heating
fixtures in your home. Includes
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Write Today
HARDIN LAYIN CO.
40 Years at
4534-46 Cottage Grove Avenue
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Keeps Auto Warm

Whether Engine Is
Running or Not



Clark Heater
A POPULAR AUTOMOBILE HEATER

Clark Heaters

Don't give up driving because of cold weather. Here's warmth that makes driving comfortable and enjoyable. Keeps you cozy in coldest weather. Whether you drive for ten minutes or sixteen hours the warmth is even and constant.

Inexpensive—Lasts Forever

The Clark Heater is moderate in price and simple and inexpensive to operate. No high priced gasoline used. No flame, no smoke, no smell. Outside, it is carpet covered. Very handsome. Looks like a foot rest. Inside, it is heavy riveted sheet steel, asbestos lined. It lasts forever. The heat is supplied by our celebrated Clark Carbon Brick. One brick gives heat 12 to 16 hours and half brick 6 to 8 hours.

Get a Clark Heater from Your Dealer

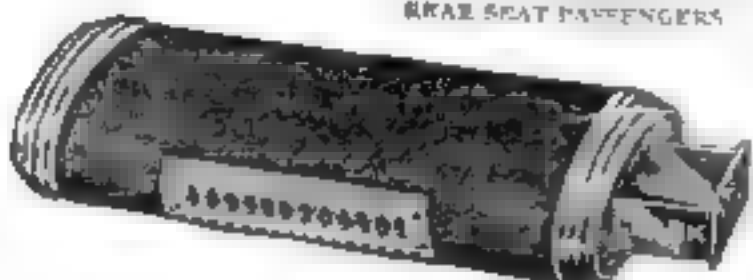
Automobile Supply dealers, garagemen, carry Clark Heaters. Made in twenty styles, \$2 to \$10. If you cannot get it at your dealer's, send your order direct to us, giving dealer's name. Send for our free catalog today.

CHICAGO FLEXIBLE SHAFT CO.

Dept. J, 608 N. LaSalle Street
CHICAGO, ILL.

(Cut of Heater No. 3 A)

A HEATER DESIGNED FOR THE
REAR SEAT PASSENGERS



Simply Pull

This
Handle

—and the Simplex
Starter positively
starts your Ford.

If it doesn't, send it back
and get your money.

No more cranking no more broken arms no more climbing out into rain and mud and cold. The Simplex cannot lock, and you'll never have occasion to. Any woman or child can operate it. It's the only practical simple, low priced guaranteed Ford Starter made.

The Simplex **\$10**
Ford Starter
The Guaranteed Starter (Price Advance)
(Dec. 1st to 12th)

Thousands in Daily Use

and every one making good. Has been successfully used for three years.

Everything concealed beneath the hood except the handle which projects through the dash. No connection with engine when not being used. Made substantially of the very best material, no rattle no moving parts to wear out, no complicated bearings or gears on crank shaft.

Dealers Wanted

In every community, Simplex Starters are good sellers because they're good starters. There's a liberal profit for the dealer. Every Ford owner is a prospect; and every sale made makes many more. Remember it's guaranteed. Write for special terms to dealers.

Order Today—at Our Risk

Send draft or money order today for \$10.00 and we'll deliver Simplex to you by prepaid Express. Put it on your car and use it 10 days. Then if you're not satisfied send Simplex back at our expense and we'll refund your money. If you want it sent C. O. D. send \$1.00 to cover express charges and pay the balance (\$9.00) when Simplex arrives. If you're a dealer send full price we'll give you credit for dealer's discount.

**SIMPLEX MFG.
COMPANY**

Box 456
Anderson,
Indiana

Simplex Mfg. Co.
Box 456
Anderson, Indiana

Enclose \$10.00 for one Simplex Ford Starter, subject to your guarantee of a refund if returned within 10 days after receipt.

Name
Address

(If a dealer send us your business letter head with coupon.)
After December 1st, 1917—price \$12.50



Temper Tested Blades

THAT'S where the true test of skate worth comes—in the blades. Are they flawless? Is their temper true? The unqualified answer to those questions when asked about Barney & Berry skates is "Yes!" We demand those things in every pair of skates we put out.

First of all, we use only steel which is ordered to our own analysis. Every lot when received is analyzed and tested for tensile strength. Our high standard must be reached for the steel to qualify for Barney & Berry skates. Then, the final hardening is checked by magnetic process and scleroscope test, making positive that the blades are of proper temper.

The Barney & Berry line includes more than forty styles for you to choose from. Whatever your skate need there is a B & B style to meet it. Top-notch dealers carry the Barney & Berry line, and will gladly show you the skates best adapted to your requirements.

FREE ON REQUEST

Booklets on "How To Skate," "B & B Skaters' League" and complete Illustrated Catalog of B & B Ice Skates mailed to you FREE if you will send your name and address to us.

BARNEY & BERRY, Inc.
1093 BROAD ST., SPRINGFIELD, MASS.



Three Big Questions in Developing a Machine

What effect have mechanical improvements on output?

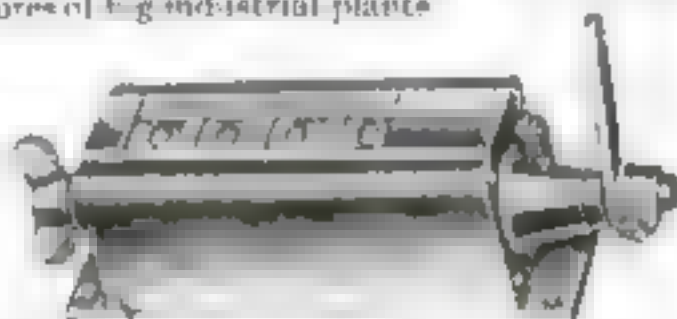
What method of operation gives the biggest production?

What rate of production should be maintained for greatest efficiency?

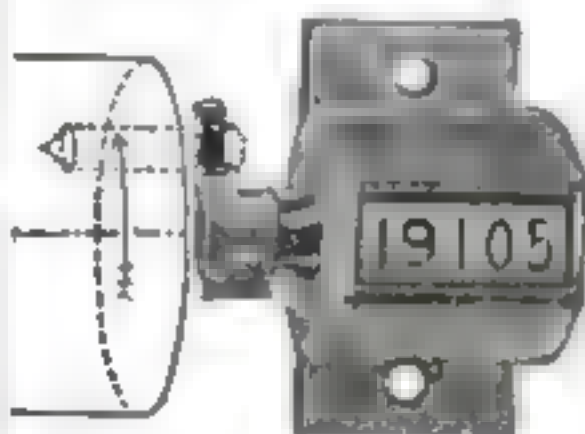
These questions are answered by

Veeder COUNTERS

Your machine, Veeder-equipped, records as it produces. By showing up the slightest gain in production these counters guide you in making the gain bigger. They make your machines more valuable producers, just as they've done in scores of big industrial plants.



The above **Set-Back Rotary Ratchet Counter** registers one for each reciprocating movement, recording an operation. Set back to zero by simply turning knob. This counter can be furnished with any number of figure-wheels up to ten. Price, with four figure-wheels, \$9.50.



The **Revolution Counter** shown at left counts one for each complete revolution of a shaft. Its action is smooth and uniform, and it will stand a very

high rate of speed, which makes it especially suitable for experimental work. It run backwards, this counter will subtract. Price, \$1.25.

We have counters for every manufacturing and experimental purpose—you can see all the models by simply sending for booklet.

THE VEEDER MFG. CO.
44 SARGEANT ST., HARTFORD, CONN.



THE Bausch and Lomb BALOPTICON

Entertains through the sense of sight as the phonograph does through the ear. The Balopticon is not a toy but a very practical instrument, designed to meet every requirement of a projection lantern. Various models for use with lantern slides or for the direct projection of opaque objects such as photos, post cards, specimens, etc. Also combination models for both methods, with instant interchange. The new gas-filled Mazda lamp gives an illuminating

ray 100% superior to the old style incandescent lamp that uses less current. The entire instrument is so simple enough for a child to operate. Prices range from \$7.50 to \$15.00.

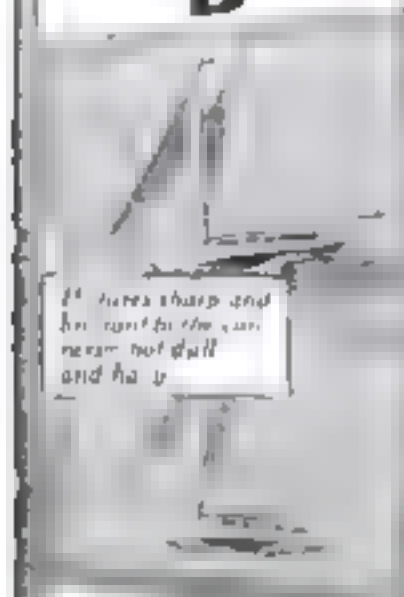
Write for booklets about the Balopticon—also price lists.

Bausch & Lomb Optical Co.

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New York Washington Chicago San Francisco

Leading American Makers of High Grade Optical Products.



Type like
this—
not like
this

FINCK'S DETROIT SPECIAL OVERALLS and COMBINATION SUITS



Better Wear—More Comfort

When you've much tested Finck's

Overalls, you'll find them to be the best made and most comfortable ever worn.

Overalls \$1.75 and \$2.00

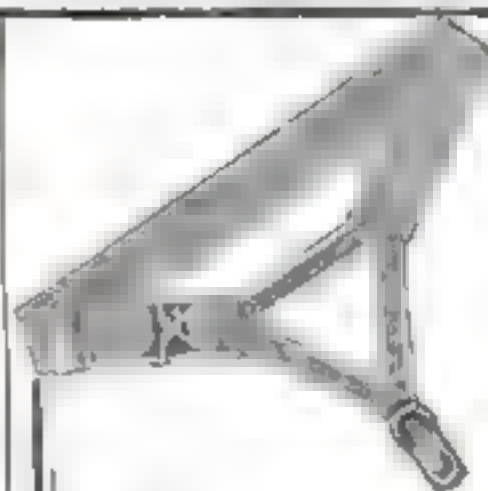
Jackets \$1.75 and \$2.00

Combination
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Branches: St. Louis, Mo.
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A PIECE OF
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You Can't Feel Them

But by a sense of security you know they are "there"—because

NEVERBIND

Boston Garter

holds the sock snugly without binding. And you know it by the neat and trim appearance of your ankles.

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Here's a great Gilbert Toy boys—Mysto Magic Sets with which you can perform wonderful feats of magic just as they are done on the stage. You can earn money giving shows in your home, or at parties, socials, churches and theatres.

Famous Tricks of the Greatest Magicians

Gilbert Mysto Magic Set 2004 contains scores of the best tricks of famous magicians with elaborate Magic Wand, large poster and big Manual of Magic Knowledge the greatest book on magic ever written tells how to do a number of fine tricks not requiring special apparatus like the Multiplying Dollar Bill, Disappearing Tumblers, etc. Price of No. 2004 Set \$5.00 in Canada, \$7.50. Other Sets \$1 to \$10.00 (Canada \$1.50 to \$15.00).

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Send for it today. Have money and buy one of the sets it describes or ask for one for Xmas. Sold at all toy dealers and department stores.

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COMPLETE Model Outfit and Instruction Book \$1.00

Make 3 times as many real working models. Use construction material many times. Buy more at only 50¢ per 100 ft. Make bridges, wind mills, engines, hoists, battleships. Follow the book or invent your own. Enter our prize contest (see the book).

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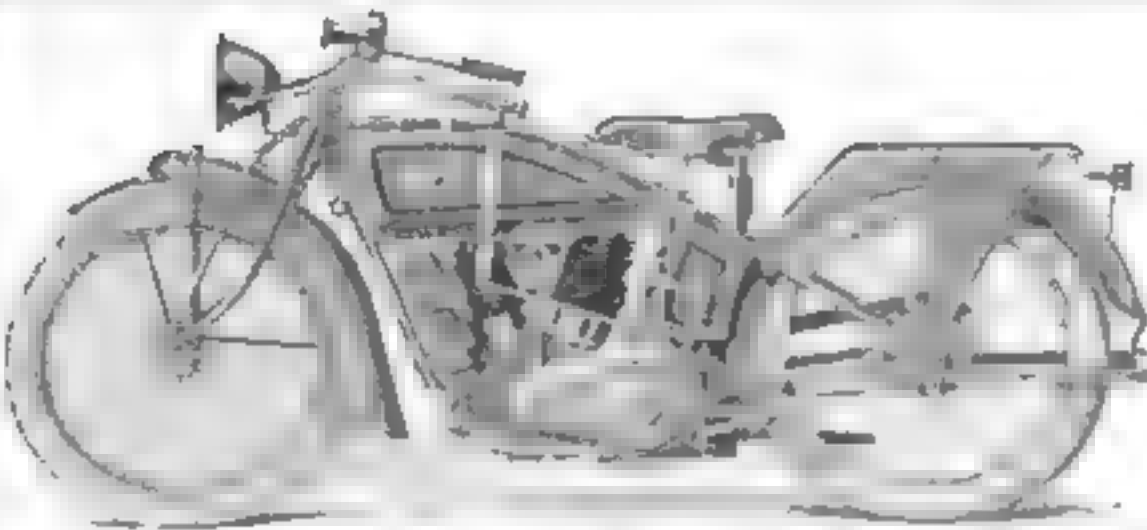
Strong, thick patented strips in many beautiful colors. Can be bent 2 ways, cut in any number of equal lengths. Practical, inexpensive, serviceable. Buy more as you learn to build. Models taken down or set up without tools. Makes permanent useful things: baskets, lamp-shades, play houses, etc. or mechanical models and toys that can be taken down.

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If you want to see what Flexo-Build makes, get our free book. Or send \$1.00 for outfit. Other outfits at similar low prices. Money back if not delighted with Flexo-Build outfit.

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An Achievement
of Science

The Master Motorcycle

Series 19

Military Model

EXCELSIOR

We announce with pride the appearance of the **EXCELSIOR**, Series 19, Military Model Motorcycle. Like all of the **EXCELSIORS** of the past ten years the new **EXCELSIOR** leads the field in excellence of workmanship, and in the strength and goodness of materials and like all its predecessors is possessed of many features of superiority which many of them exclusively **EXCELSIOR**, tend to make the **EXCELSIOR** Series 19, the most comfortable, most easily operated, most nearly perfect and the strongest motorcycle ever built.

A FEW OF THE FEATURES

Extra Large, roller bearing, multiple disc clutch, with removable bearing faces.

Double Truss, Military Type Front Fork, the strongest fork ever put on a motorcycle.

Excelsior Cushion sprocket equalizes the pull and conserves every ounce of power delivered by the motor.

Removable Center Bar permits quick and easy access to the motor and removal of cylinders without interference with any other part of the power plant.

Inclosed clutch and motor drive chain, protects these important parts from dirt and road grit.

Foot starter and Automatic Compression Control assure a quick and easy start, always,—in any kind of weather.

Tubular steel luggage carrier with steel tool box.

Rustproof, Military Olive Drab Finish, including hubs, spokes, etc.

THE FINEST MOTORCYCLE ON THE MARKET

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USED IN THE ARMIES AND NAVIES OF THE WORLD



For Christmas give **PARKER** **SAFETY-SEALED** **FOUNTAIN PENS**

FOR the boys at the front, for relatives, friends and sweethearts. The enduring gift, always appreciated, always useful.

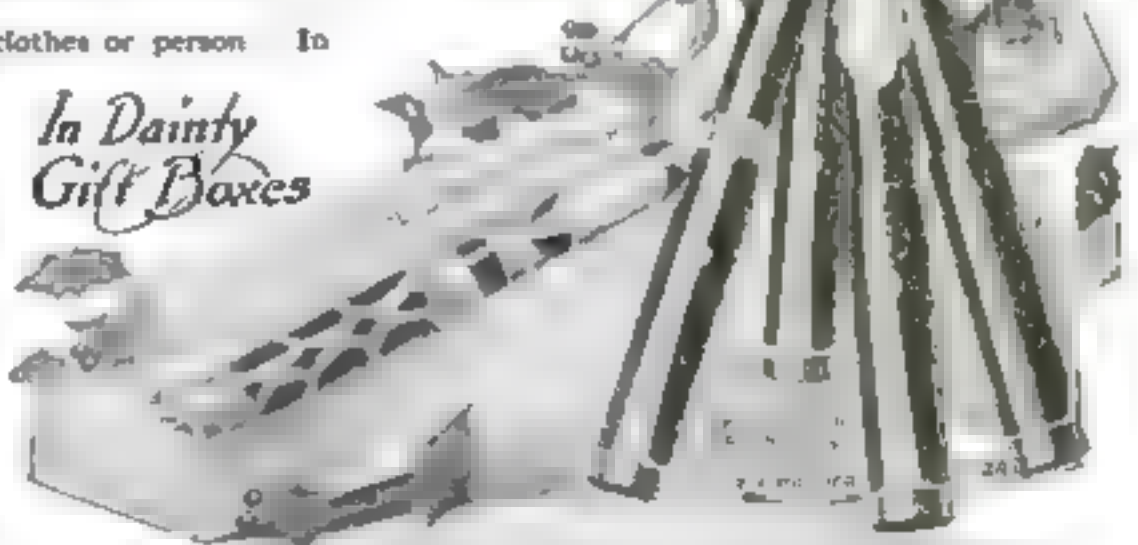
Parker Self-fillers are *safety-sealed*; the new type "no holes in the wall" fountain pens.

Ink can't get out to soil clothes or person. In event of accident to interior mechanism, the pen automatically changes from a Self-filler to a non-Self-filler without interruption of service. Because of these exclusive features it's the pen for the army and navy, where only dependable pens are wanted.

Your search for suitable gifts is at an end—decide on **PARKER FOUNTAIN PENS**. The name is your guarantee of quality.

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*In Dainty
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No. 20-92.00
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Parker Clips
25c extra

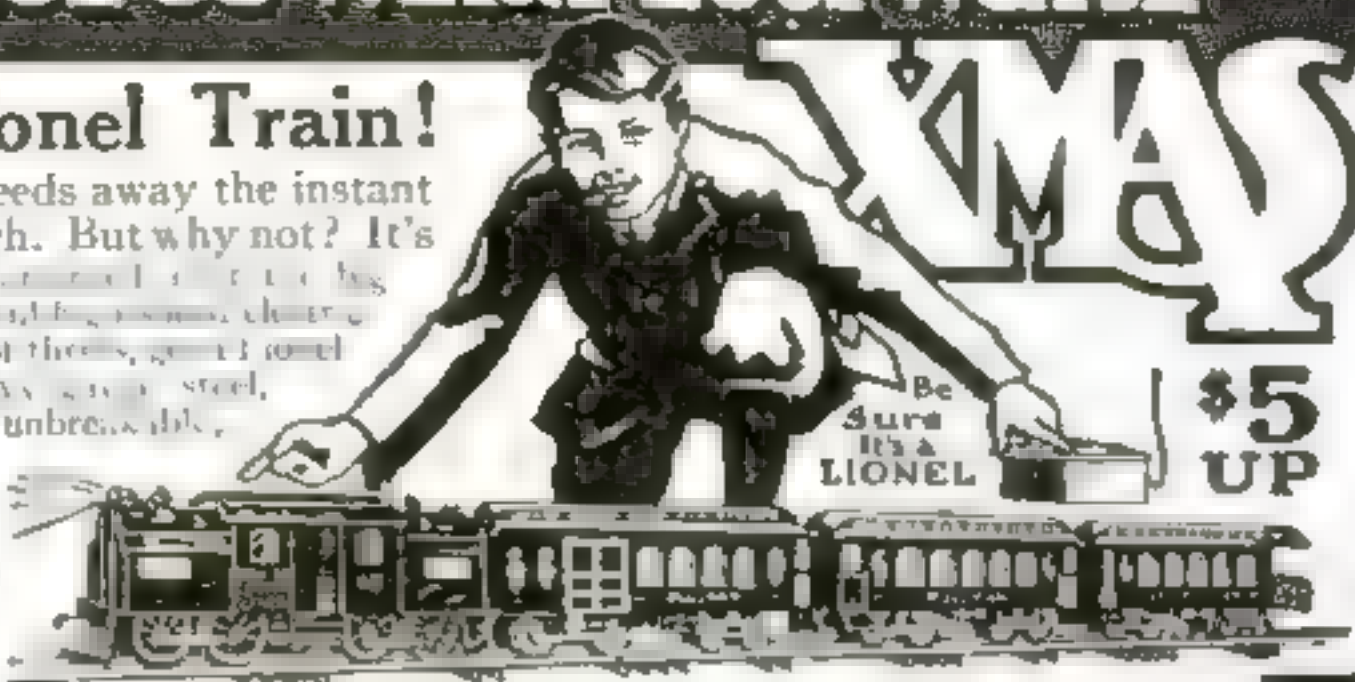
Ink tablets in
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a Real Lionel Train!

Zingo! How it speeds away the instant you touch the switch. But why not? It's a real, working train, perfect in every way—run by a powerful, long-lasting electric motor. For a model of this, get the Lionel Train! Made of heavy steel, beautifully enameled, unbreakable, good for years of fun. Operates at low voltage on batteries, or on house current with Lionel Multivolt Transformer. Absolutely safe.



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—showing complete line of freight and passenger sets—over a hundred fascinating pictures. Pick out your gift and, if not at your dealer's, I'll ship prepaid on receipt of price.

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LOOK! A Dandy New LIONEL TRANSFORMER

Attaches to your home current. Runs electric trains and electric toys and small apparatus. 2 to 30 volts. At your dealer's or shipped prepaid on receipt of \$3.40. Others up to \$8.

\$3.40

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BILLIARD AND POOL TABLE

can be mounted on dining or library table or on its own legs or folding stand. No special room is needed. Put up or down in a minute. Sizes range up to 4 1/2 ft. standard. Prices of Tables \$15 up. Balls, cues etc. free. Burrowes Tables are splendidly made in every particular and adapted to the most skillful play. The Burrowes Regis High-Speed Rubber Cushions are the best made. Burrowes Tables are now on sale in many cities and towns. You can inspect them before ordering if you wish. **FREE TRIAL**—Write us for catalog illustrating containing free trial offer, prices, terms, order blanks, etc. **THE E. T. BURROWES CO., 51 Spring St., Portland, Me.** Also San Francisco and Los Angeles Offices.



Ives Toys
Make Happy Boys

Here you are boys! Throw open the throttle of that big powerful Ives locomotive, with its long, low streamline body—the very latest type. Watch the big driving wheels spin. She's off! See her pull that train along. Now work that switch! She's crossing over! Press it again! She's slowing up! Now she's stopping at the station.

Get an Ives Train and track. Ask your folks for one for Christmas. Passenger cars, freight cars, coal cars, cabooses—just like real. Electric and mechanical locomotives—bridges and signals that you can build yourself with Ives Struktiron. Write for free folder today—and name of Ives dealer near you.

THE IVES MANUFACTURING CORPORATION

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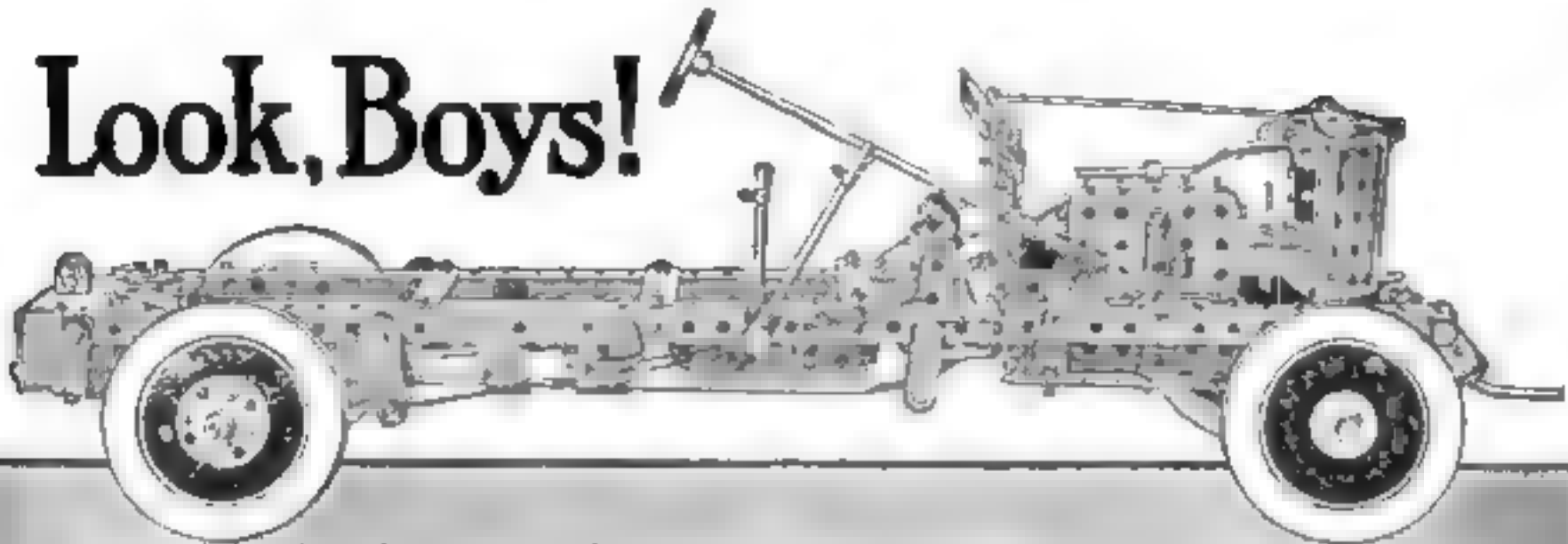
Bridgeport, Conn.



BOYS! GET THIS BOOK

A really gorgeous book, with big pictures of trains in real colors and colored designs used on the cars. Tells about electricity and history of Ives Toys. Send five 2 cent stamps for it to pay postage packing, etc.

Look, Boys!



You Can Build This Dandy AUTO with MECCANO

It is all built from regular MECCANO parts. It is just like the chassis of a real automobile, with clutch, worm steering gear, speeds, transmission, universal joint, differential, brakes, springs and all other working parts of a big car.

Just think of an engineering toy that will build models like that! You couldn't build this auto with anything but MECCANO because it is made up of special patented parts that come only with MECCANO.

And this is only one of the scores of fascinating models you can make with this world-famous engineering toy. The Meccano Manual, which is contained in all sets from No. 1 up, pictures hundreds of other wonderful models. Or you can build some model of your own—something you have seen and would like to make. And then the next day you can have out as much fun building something entirely different with the same parts. And think of this: MECCANO builds real working models—high towers with electric elevators, derricks that hoist heavy loads, cranes that swing around, bridges that open and close, steam shovels that you can dig with!

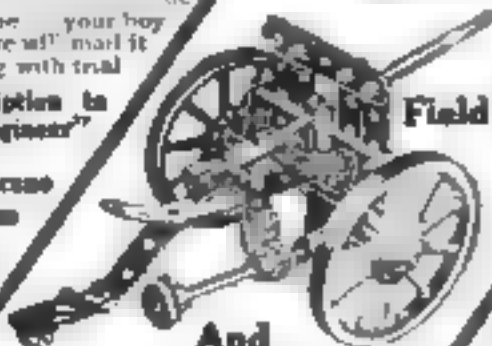
Nothing else you could own would give you as much real sport as a set of MECCANO—it's just like a Magic Box of fun!



MECCANO Wonder Book Free to Boys

Lots of fine drawings. Send your own name and the names of three of your boy friends and we'll mail it to you, along with trial.

Free Subscription to "Meccano Engineer" and details of Meccano \$1.00 No Price! Content! Write right now in this wonder book.

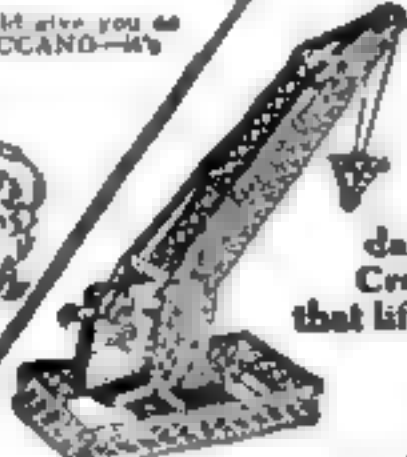


And hundreds of other Wonderful Models

You can make a new model every day with MECCANO if you want to. You never get tired of MECCANO, and it never wears out.

MECCANO is on the Box

or a dandy Crane that lifts



or a bully Field Gun

or a real Steam Shovel that digs



Your Fun has only Begun when you have built one model. For with MECCANO you can take the same parts and build—



A regular Army Aeroplane

Tell Your Folks WHY You Want MECCANO

True Engineering For a MECCANO set is made up of accurate, standardized parts just like real engine parts. Only smaller. You can use them over and over again and build all sorts of models.

Fun Right Away. With MECCANO you can begin building models and having fun right away, before you open the box. You don't have to study. MECCANO Manual shows you just how to go ahead.

Models that Run Like Real Machinery. MECCANO parts are so accurately made that you can build models that will run just like a piece of regular machinery. Think of building such things as Clocks that keep time, Lamps that actually burn, Motor Cars and Engines that run. Machines that draw beautiful designs.

Each MECCANO Set Complete. Whether it costs \$1 or \$40! You don't have to keep buying parts.

Build Almost Anything with MECCANO. You won't get tired of MECCANO like you would of any ordinary building toy because MECCANO sets are so complete and the parts are so made that you can build not only the models in the Manual but also scores of models of your own. That's the fun of MECCANO—you can build almost anything!

Cash Prizes. There are always MECCANO competitions and cash prizes for the best, most original models. Perhaps you can win one of the prizes.

BE SURE YOU GET MECCANO

Now you can see why you want to be sure to get MECCANO. There isn't anything else just as good as just the same. So say the name over to yourself: MECCANO, MECCANO, MECCANO! Then tell Mother and Dad about MECCANO, and tell them why nothing else will give you as much fun as MECCANO will.

Prices of MECCANO Sets

MECCANO sets include various sizes of dandy girders, plates, and various sized angles, also nuts, bolts, washers, gears and wheels of other parts, all cut from aluminum steel and brass, set as carefully as the works of a clock. Each regular outfit from No. 1 to No. 6, is complete with tools and full instructions. Nothing more to buy. Sets numbered 7 to 12 contain the wonderful MECCANO Electric Motor. Any set sent postpaid upon receipt of price, if not at your dealer's.

No. 00	\$2.00
No. 0	1.50
No. 1	3.00
No. 2X	4.50
No. 3	6.00
No. 4X	7.50
No. 5	9.00
No. 6X	12.00
No. 7	15.00
And up to \$40.00	

MECCANO COMPANY, Inc. Building 10K, Bush Terminal, Brooklyn, N.Y.



Our Sales Plan Calls for Additional Distributors

Controlling the local exclusive selling rights of

Kor-Ker

AMERICA'S STANDARD

TIRE TREATMENT



We want big men who can organize and conduct a selling organization—appoint sub-agents, supply the auto accessory trade, etc., and finance their initial order in return for exclusive selling rights.

The man who wants a job need not apply.

Only the man who can build up and carry on an efficient selling organization will be acceptable



KOR-KER is being advertised in such national magazines as *Literary Digest*, *Collier's*, *Life*, *Leslie's*, *National Geographic*, *System*, *Metropolitan*, *Review of Reviews*, *The World's Work*, *Harper's*, *American Magazine*, *Motor*, *Everybody's*, *Every Week*, *The Independent*, etc.



Diagram Showing the Action of Kor-Ker

KOR-KER seals punctures on the go. Stops slow leaks. Keeps tires up to normal inflation. Preserves rubber. Doubles the life of inner tubes. Reduces blowouts to a minimum. Tubes can be changed from one casing to another.

KOR-KER is a compound based in powder form. Is mixed with water and readily installed through valve stems. KOR-KER will do a great deal more than we claim for it. These are facts that can be readily substantiated. We have distributors in U. S., Canada, England, France, Russia, Norway, Sweden, Holland, Spain, Portugal, India, Egypt, South Africa, South America, Australia, New Zealand, Java, Philippines and Trinidad.

There's a big liberal profit in it for you. But first make us prove to your own satisfaction that we've got the goods. Then let us tell you what other dealers are doing with KOR-KER. We invite the most thorough investigation. If you want further details write fully and frankly regarding yourself to the General Manager.

ALCEMO MANUFACTURING CO.,
6 Bridge Street, Newark, N. J.

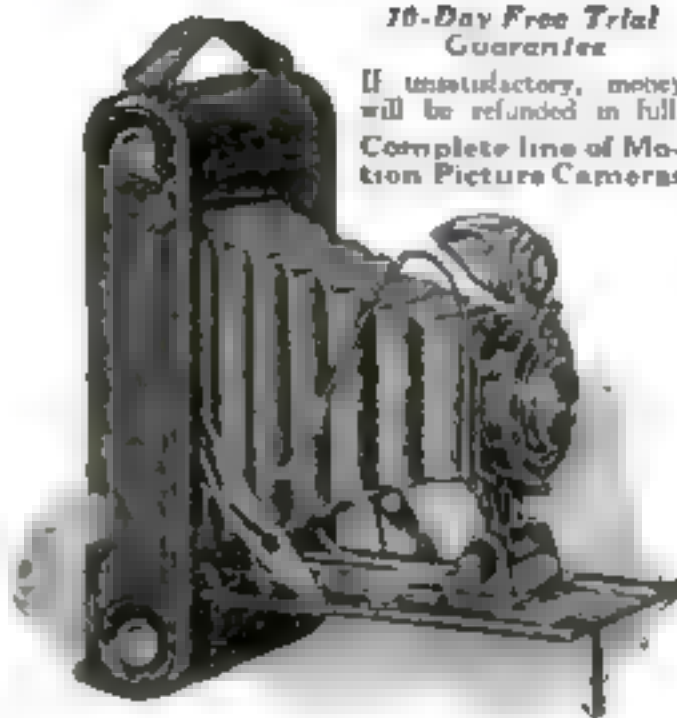
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10-Day Free Trial Guarantee

If unsatisfactory, money will be refunded in full. Complete line of Motion Picture Cameras



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CENTRAL CAMERA CO.

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Earn \$1500 to \$5000 Yearly

Here's your big chance to become a full-fledged Civil Engineer! ~~HERE ARE SOME~~ books you can fit yourself to make big money, in greatest outdoor profession on earth! Offer fully explained in coupon (good only within boundaries of U. S. and Canada).



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Nine big leather-bound volumes, 4000 pages, 7 x 10 inches, 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying, highway construction, railway engineering, earth work, specifications, estimating, contracts, bridge engineering, masonry, reinforced concrete, water supply, sewers and drains, water power equipment, irrigation engineering, etc., etc. Written in simple language—every point made plain.

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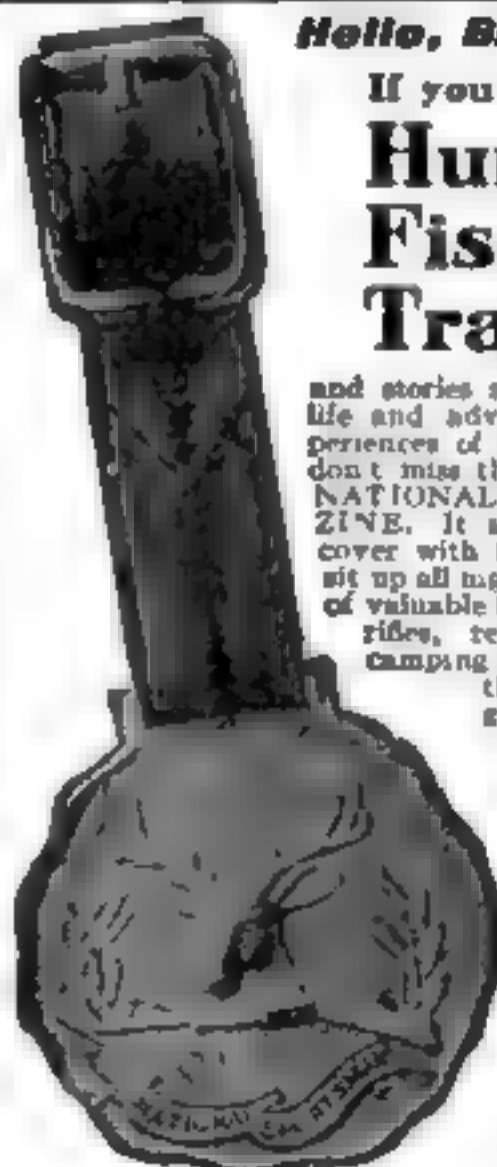
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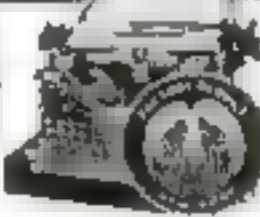
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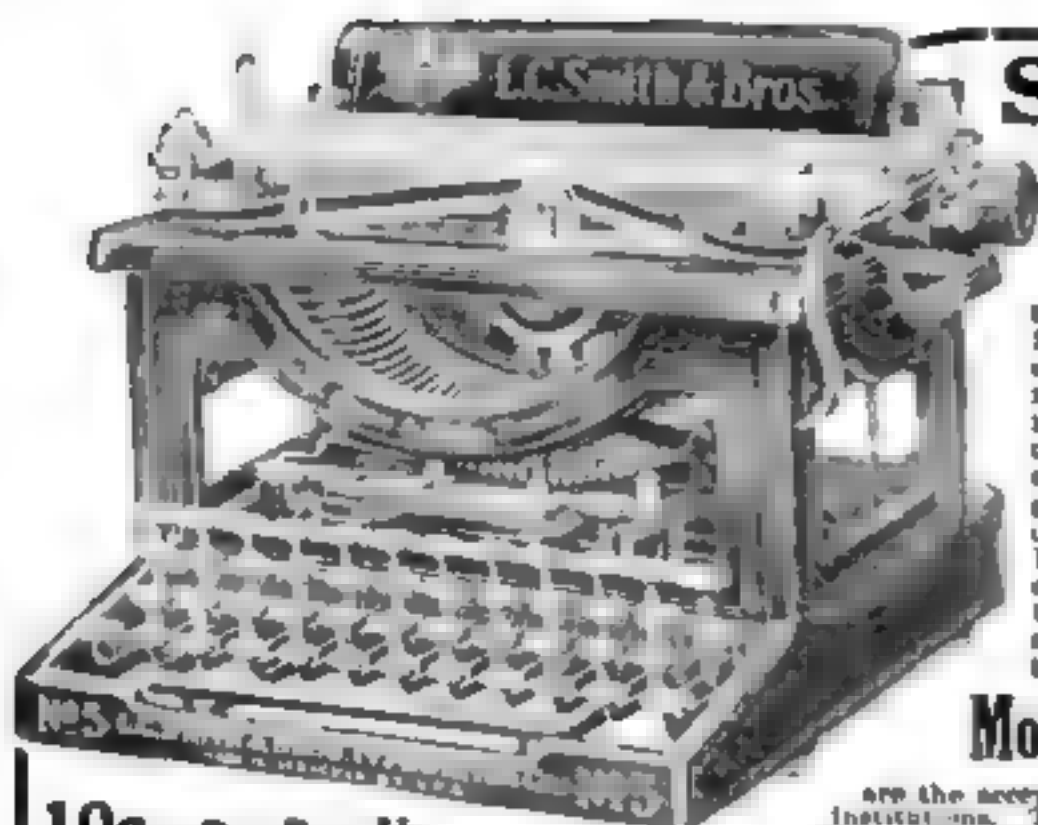
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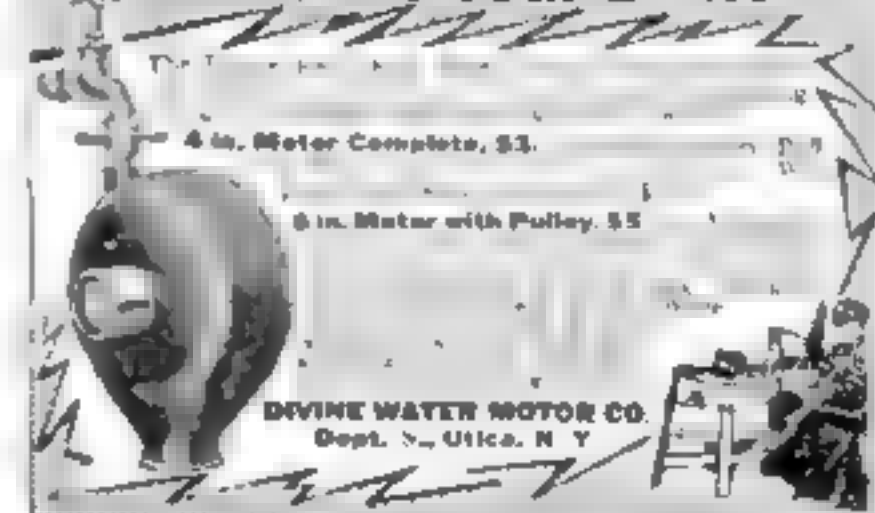
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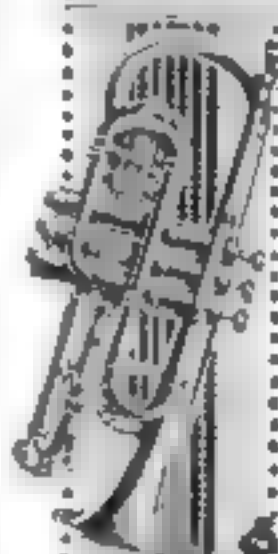


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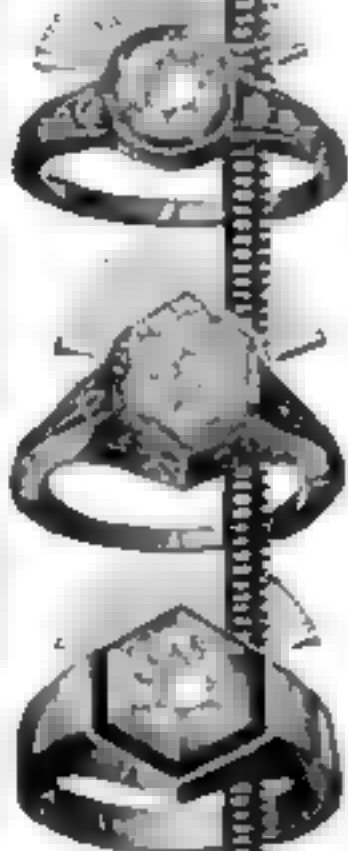
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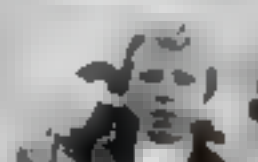
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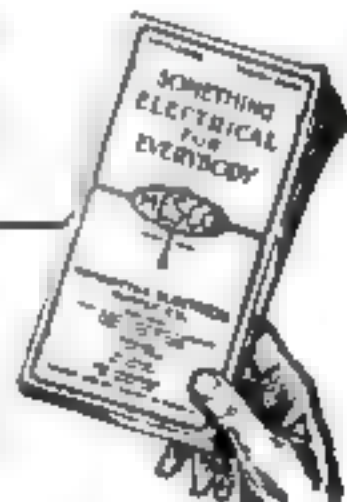
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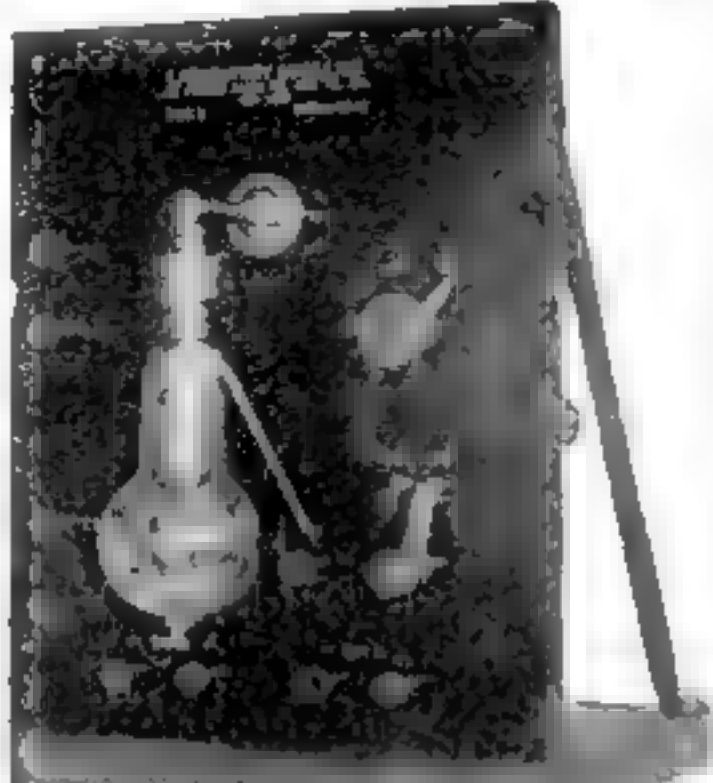
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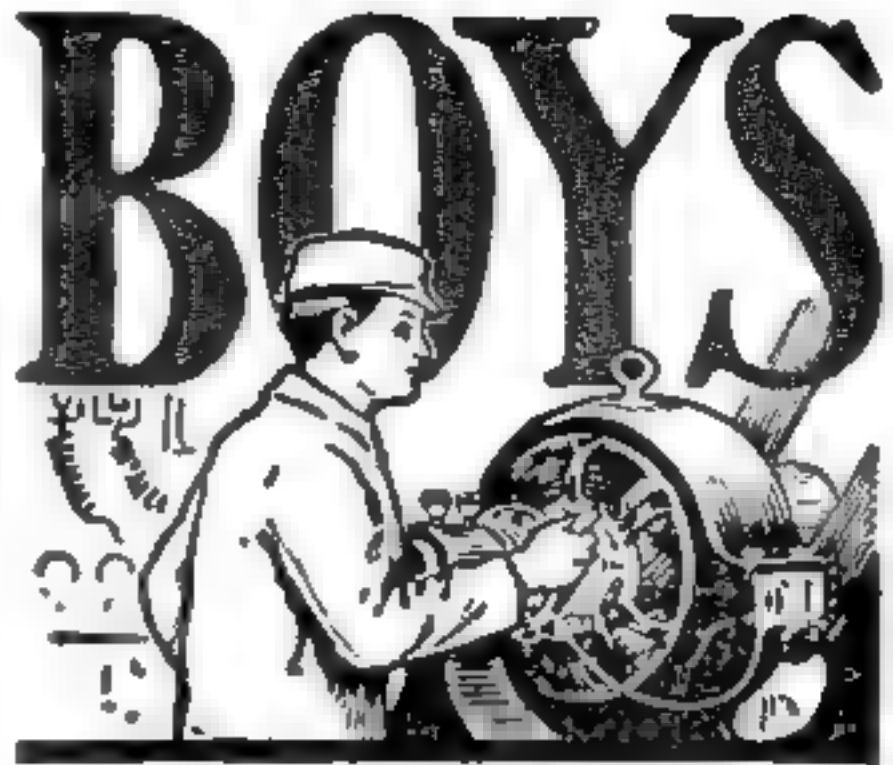
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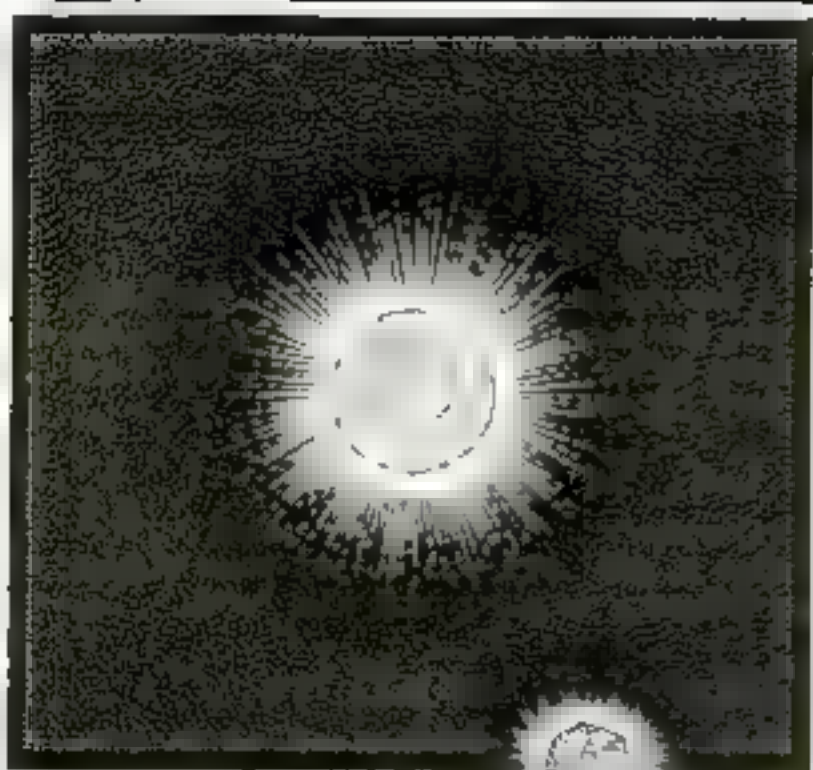
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Leaders)	" " "	2 50	per 40-pound sack
	" " "	1 70	per 24 1/2-pound sack

HERE IS OUR PLAN

Send us \$1.00 for the following Trial Order and we will then know that you mean business and we will include with your order our Bargain Grocery Catalogue in which you will find big grocery bargains.

TRIAL ORDER A.S.

	Estimated	Retail Price	Our Price
5 pounds Our Best Granulated Sugar	50 cents	35 cents	35 cents
1 large size package cooking Oil	10 cents	7 cents	7 cents
1 pound Cream of Tartar Baking Powder	30 cents	20 cents	20 cents
1 pound Black Pepper (ground)	25 cents	15 cents	15 cents
1 pound Cinnamon (ground)	25 cents	15 cents	15 cents
1 pound Ginger (ground)	25 cents	15 cents	15 cents
1 pound Allspice (ground)	25 cents	15 cents	15 cents
2 bars Kirk's White Flake Soap	10 cents	9 cents	9 cents
2 packages Urethra Abrasive	10 cents	8 cents	8 cents
1 bar Eola Naphtha Soap	5 cents	3 cents	3 cents
1 pound Breakfast Cereal	60 cents	30 cents	30 cents
5 packages Washing Powder	15 cents	10 cents	10 cents
1 Catalogue Free	Retail Price \$1.72	Our Price \$1.49	

OUR GUARANTEE: Your money returned in full if you are not more than pleased.
COLE-CONRAD CO., Dept. A. S., 2218 Ogden Ave., Chicago, Ill.

SUGAR - \$5.00 Per 100 Lbs.

	Our Best Granulated Sugar	\$5.00 per 100 lbs.
(One of Our Leaders)	" "	2.50 per 50 lbs.
	" "	1.25 per 25 lbs.
	" "	.50 per 10 lbs.

Other Big Bargains in our Catalogue

Other Big Bargains in our Catalogue
 French Biscuits 12 packages 40 cents, Quaker Oats, 6 large
 pie tins 30 cents. **AND OTHER BIG BARGAINS.**

Remember

We sell the trial order complete only and no part of same. Nor do we sell any article advertised in this advertisement separately. Rush your trial order at once and get our catalogue and commence saving big money on all your groceries.

ORDER BLANK

Cals-Conrad Co., Dept. A-9, 2214 Ogden Ave., Chicago, Ill.

1. Customer - I ordered please find \$1.99 for which send me
Bargain Grocery Order No. A-4 and include free your catalogue
also by your Big Grocery. Because it being understood and
agreed I am not perfectly satisfied that I can return the
goods and you will at once return my money.

Name	Address	City	State	Zip
John Doe	123 Main St	New York	NY	10001
Jane Smith	456 Elm St	Los Angeles	CA	90001
Bob Johnson	789 Oak St	Chicago	IL	60601
Alice Brown	101 Pine St	San Francisco	CA	94101
Charlie Davis	202 Maple St	Phoenix	AZ	85001
Diana White	303 Cedar St	Philadelphia	PA	19101
Frank Green	404 Birch St	San Diego	CA	92101
Grace Black	505 Walnut St	Seattle	WA	98101
Henry Blue	606 Spruce St	Portland	OR	97201
Ivy Red	707 Ash St	Denver	CO	80201
Jack Yellow	808 Hickory St	San Jose	CA	95101
Karen Purple	909 Cypress St	San Antonio	TX	78201
Leo Brown	1010 Dogwood St	San Jose	CA	95101
Mia Green	1111 Magnolia St	San Jose	CA	95101
Noah Blue	1212 Sycamore St	San Jose	CA	95101
Olivia Red	1313 Tulip St	San Jose	CA	95101
Peter Yellow	1414 Violet St	San Jose	CA	95101
Quinn Purple	1515 Zinnia St	San Jose	CA	95101
Rachel Brown	1616 Aster St	San Jose	CA	95101
Sam Green	1717 Begonia St	San Jose	CA	95101
Tina Blue	1818 Camellia St	San Jose	CA	95101
Uma Red	1919 Dandelion St	San Jose	CA	95101
Victor Yellow	2020 Foxglove St	San Jose	CA	95101
Wendy Purple	2121 Geranium St	San Jose	CA	95101
Xavier Brown	2222 Hibiscus St	San Jose	CA	95101
Yara Green	2323 Iris St	San Jose	CA	95101
Zoe Blue	2424 Jasmine St	San Jose	CA	95101
Adam Red	2525 Lavender St	San Jose	CA	95101
Eve Yellow	2626 Marigold St	San Jose	CA	95101
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Grace Brown	2828 Rose St	San Jose	CA	95101
Harry Green	2929 Sunflower St	San Jose	CA	95101
Ivy Blue	3030 Verbena St	San Jose	CA	95101
Jack Red	3131 Zinnia St	San Jose	CA	95101
Karen Yellow	3232 Aster St	San Jose	CA	95101
Leo Purple	3333 Begonia St	San Jose	CA	95101
Mia Brown	3434 Camellia St	San Jose	CA	95101
Noah Green	3535 Dandelion St	San Jose	CA	95101
Olivia Blue	3636 Foxglove St	San Jose	CA	95101
Peter Red	3737 Geranium St	San Jose	CA	95101
Quinn Yellow	3838 Hibiscus St	San Jose	CA	95101
Rachel Purple	3939 Iris St	San Jose	CA	95101
Sam Brown	4040 Jasmine St	San Jose	CA	95101
Tina Green	4141 Lavender St	San Jose	CA	95101
Uma Blue	4242 Marigold St	San Jose	CA	95101
Victor Red	4343 Petunia St	San Jose	CA	95101
Wendy Yellow	4444 Rose St	San Jose	CA	95101
Xavier Purple	4545 Sunflower St	San Jose	CA	95101
Yara Brown	4646 Verbena St	San Jose	CA	95101
Zoe Green	4747 Zinnia St	San Jose	CA	95101
Adam Blue	4848 Aster St	San Jose	CA	95101
Eve Red	4949 Begonia St	San Jose	CA	95101
Frank Yellow	5050 Camellia St	San Jose	CA	95101
Grace Purple	5151 Dandelion St	San Jose	CA	95101
Harry Brown	5252 Foxglove St	San Jose	CA	95101
Ivy Green	5353 Geranium St	San Jose	CA	95101
Jack Blue	5454 Hibiscus St	San Jose	CA	95101
Karen Red	5555 Iris St	San Jose	CA	95101
Leo Yellow	5656 Jasmine St	San Jose	CA	95101
Mia Purple	5757 Lavender St	San Jose	CA	95101
Noah Brown	5858 Marigold St	San Jose	CA	95101
Olivia Green	5959 Petunia St	San Jose	CA	95101
Peter Blue	6060 Rose St	San Jose	CA	95101
Quinn Red	6161 Sunflower St	San Jose	CA	95101
Rachel Yellow	6262 Verbena St	San Jose	CA	95101
Sam Purple	6363 Zinnia St	San Jose	CA	95101
Tina Brown	6464 Aster St	San Jose	CA	95101
Uma Green	6565 Begonia St	San Jose	CA	95101
Victor Blue	6666 Camellia St	San Jose	CA	95101
Wendy Red	6767 Dandelion St	San Jose	CA	95101
Xavier Yellow	6868 Foxglove St	San Jose	CA	95101
Yara Purple	6969 Geranium St	San Jose	CA	95101
Zoe Brown	7070 Hibiscus St	San Jose	CA	95101
Adam Green	7171 Iris St	San Jose	CA	95101
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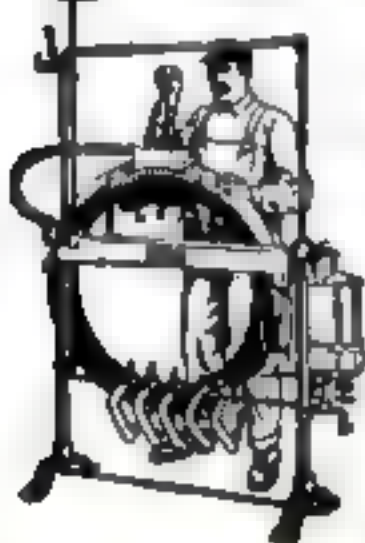
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A Lightning Edge on Safety Blades

A keener edge than you ever felt. An edge that will flash through the stiffest, wiriest hair. Only a few strokes work marvels on any safety blade. You can't fail to get a lightning edge. You can't misuse a Stag Sharpener. A child can sharpen blades on a Stag as well as an expert. Makes old blades better than new. Makes new blades better.

Stag Sharpener \$1

with barber's hone and strop and Trench Mirror complete, on our money back guarantee

Complete, including unbreakable Trench Mirror. \$1 postpaid to you on this special offer.



Protect Yourself

A dull razor is dangerous to health and life itself. The Stag Sharpener is a health protection as well as a positive luxury in shaving. The truest, simplest, quickest, easiest safety blade sharpener on earth.

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Positively gives new blades a better shaving edge. Puts the oldest, dullest blades in lightning edge condition. You can never know the delights of shaving with a positively perfect razor edge, until you sharpen your own blades with the Stag Sharpener. The quickest, truest, surest, safest, easiest. The wheels of the sharpener guide the angle. Nothing to adjust. Nothing to get out of order. Practically lasts a lifetime. Our new patented feature makes the Stag more desirable than ever. Stag Sharpeners are used around the world. Complete outfit includes heavily nicked sharpener, barber's hone, strop and Trench Mirror in neat box, suitable for traveler's kit. Complete, postpaid to you only \$1. Send now.

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Dealers

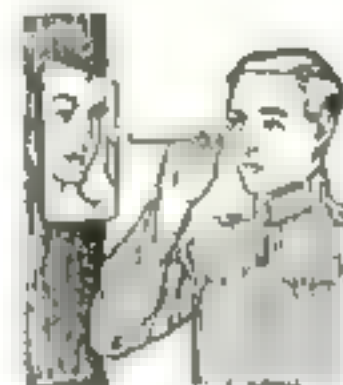
Write to us for special terms to dealers. The Stag is the quickest and best seller on earth. Get the benefit of this advertising and our Dealer Service.

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Enclose only \$1, money order, draft, dollar bill or check. Send today and make a comfortable shave for yourself. You need a Stag Sharpener. Clip coupon, put in \$1 and get it by return mail.

The Stag Company

329 Plymouth Ct., Dept. 5723, Chicago



Trench Mirror FREE

With every Stag Sharpener we will send you a Trench Mirror positively free. Can't break. The Stag Sharpener is the ideal outfit for every soldier and sailor. We have therefore decided to give a Trench Mirror free for a limited time with every Stag Sharpener. If you want the Trench Mirror alone please only 35c. It will be sent to you postpaid for only 35c. Send only \$1 for the Stag Sharpener outfit complete with Trench Mirror or for the Trench Mirror only 35c.

Special \$1 Coupon

Hone, Strop and Trench Mirror Free
THE STAG COMPANY

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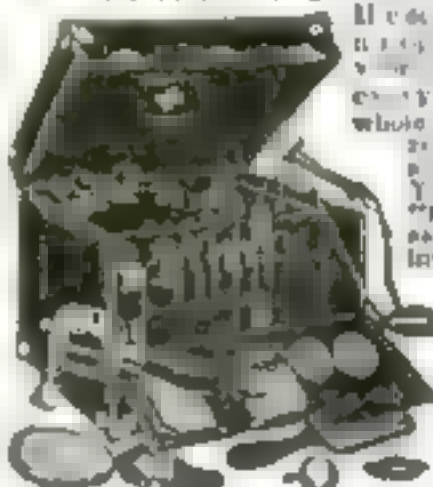
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Do you feel just right? If you do not—if you haven't that vigorous "go ahead" feeling all the time—don't fail to send the coupon for full particulars about the White Cross Electric Vibrator. In vibration there exists many of the secrets of life. You now have an opportunity of seeing what vibration will do for you—how every nerve, every fibre in your whole body will fairly tingle. Try this remarkable instrument for yourself—test it. Now is the time for YOU to send for the free book, "Health and Beauty." Thousands have received it. You are invited to write for it, too.



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For a short time only we are making a remarkable Special Introductory Offer on the White Cross Electric Vibrator, in order to place at least one of these splendid instruments in every city, town, village in the country.

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Without any obligations on my part please send me free and prepaid your free book on Vibration full particulars of the White Cross Vibrator and our Special Offer.

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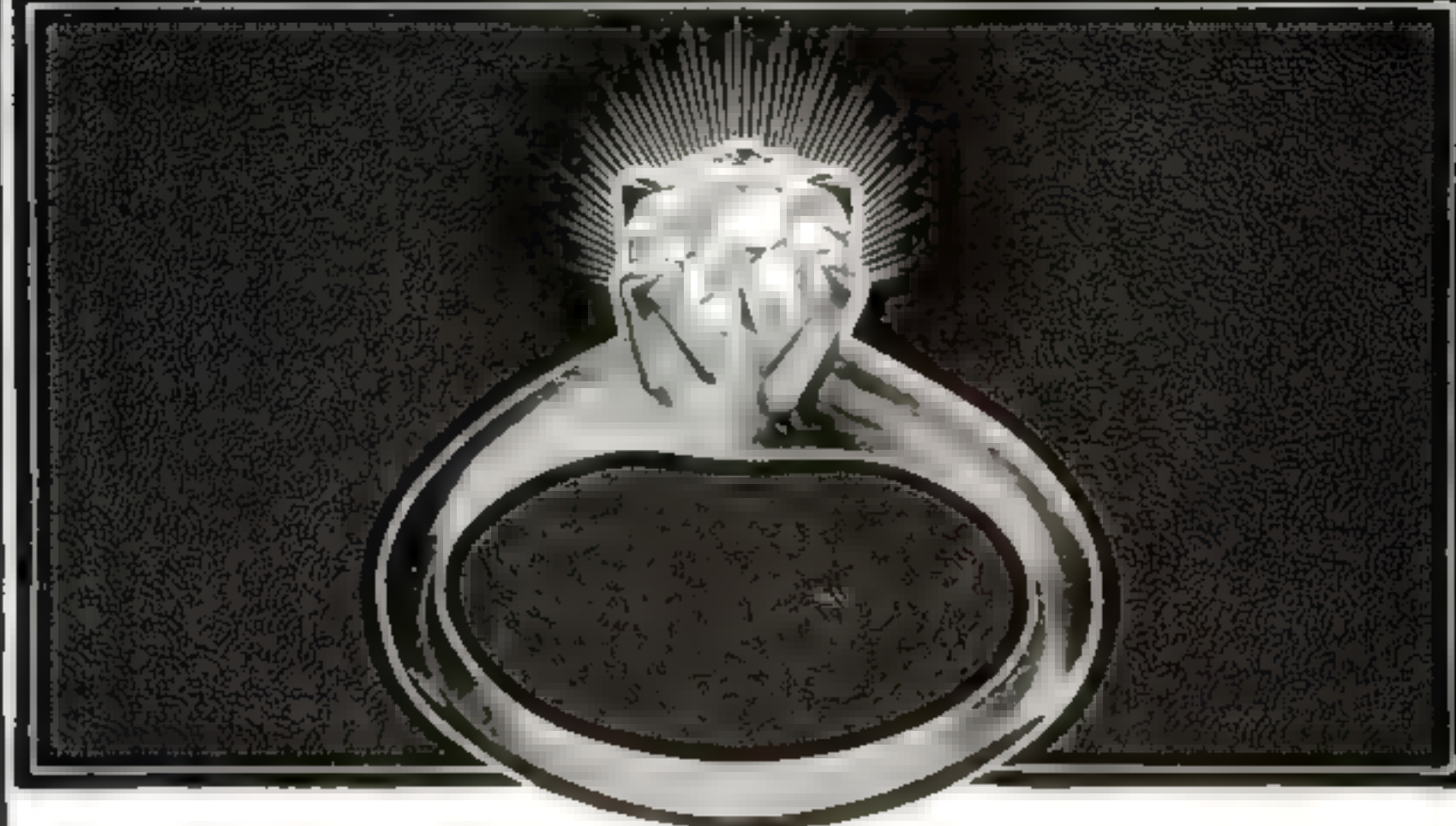
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We are manufacturing these instruments in our own factory. They are made of the best materials and are guaranteed to last for years. They are sold at a low price to the public. Send for the book today.



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Lachnite Gems are mounted only in solid gold. To hold these splendid jewels we have secured the latest and newest ideas in solid gold settings. In our new catalog you will see illustrated rings by the score for both men and women—bracelets, La Vallieres, stick pins, cuff links—all the newest jewelry—made of solid gold. Write for our new catalog today. It's free—and it has a message for you.

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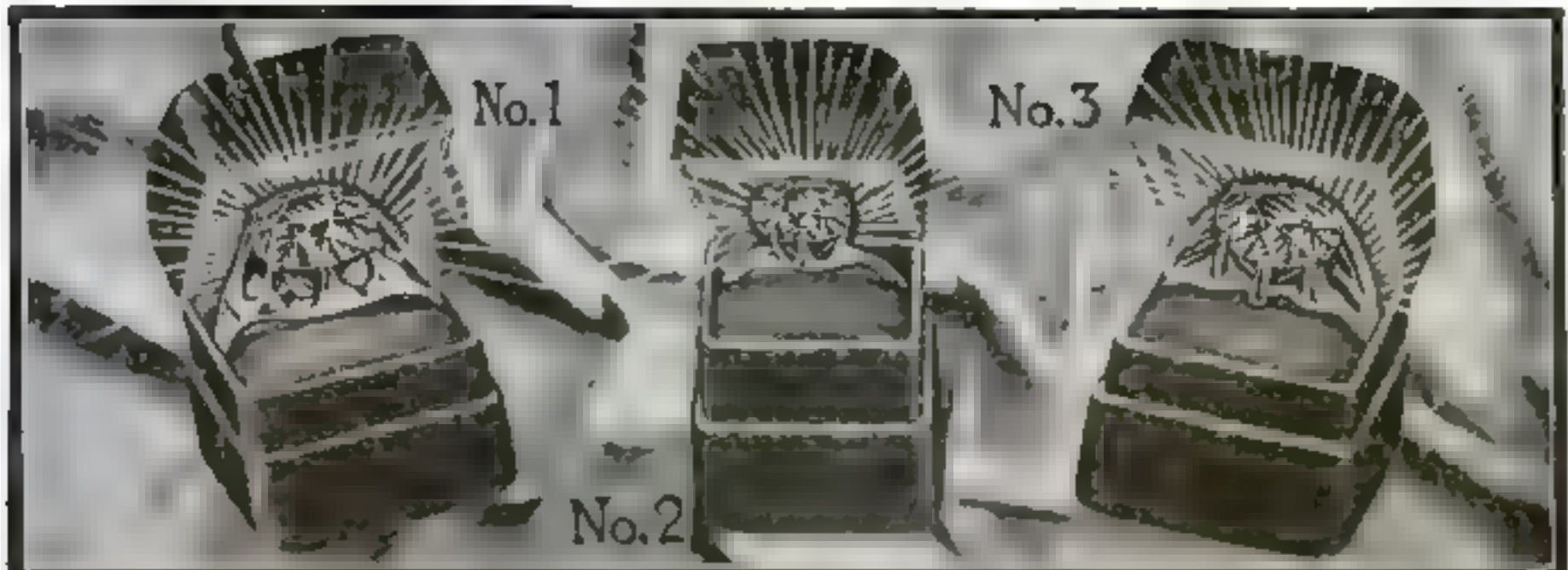
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Here is the most amazingly liberal offer ever made on precious gems. To quickly introduce into every locality our beautiful, TIFNITE GEMS—which in appearance and by every test are so much like a diamond that even an expert can hardly tell the difference—we will absolutely and positively send them out FREE and on trial for 10 days' wear. But only if you will be shipped on this plan. To take advantage of it, you must act quickly.

Send the coupon NOW! Send no money. Tell us which item you prefer—Ring, Pin or LaValiere. We'll send your selection at once. After you see the beautiful, dazzling gem and the handsome solid gold mounting—after you have carefully made an examination and decided that you like it, if you believe you have a wonderful bargain and want to keep it, you may pay for same in small easy payments as described in this advertisement. Then the Ring, Pin, or LaValiere is yours to give away, sell, or wear just as you prefer. If, however, you can tell a TIFNITE GEM from a genuine diamond, or for any reason you do not wish it, send it back at our expense.

TIFNITE GEMS

Solid Gold Mountings

are recognized as the closest thing to a diamond ever discovered. In fact, it requires an expert to distinguish between them. In appearance a Tifnite and a diamond are as alike as two peas. TIFNITE GEMS have the wonderful pure white color of diamonds of the first water, the dazzling fire and brilliancy, cut and polish.

They stand every diamond test—fire, acid and diamond file. The mountings are expertly fashioned in latest designs—and guaranteed solid gold.

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Just send coupon. You do not obligate yourself in any way. The coupon, only the coupon, brings you any of the exquisitely beautiful jewelry shown on this coupon. If you want to exchange with your friends or give as a gift, and be sure to enclose slip of paper showing exact finger measurement, as explained below.

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The Tifnite Gem Co.,
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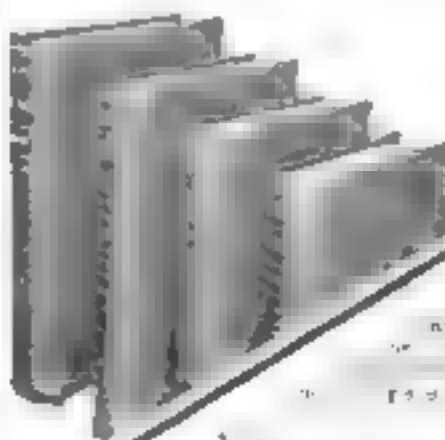
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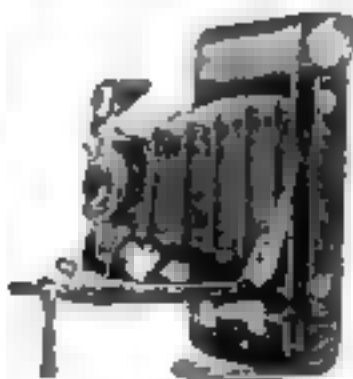
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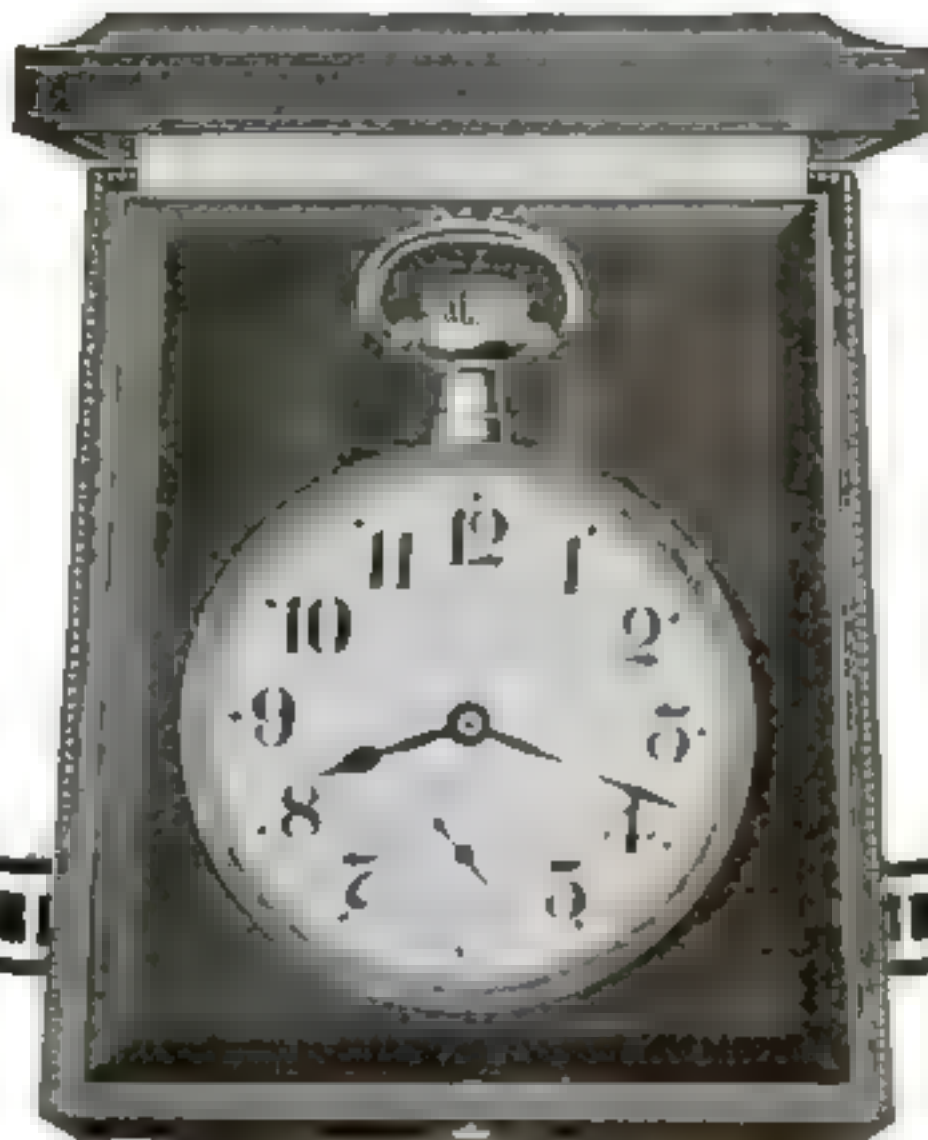
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16 Size—17-Jewel

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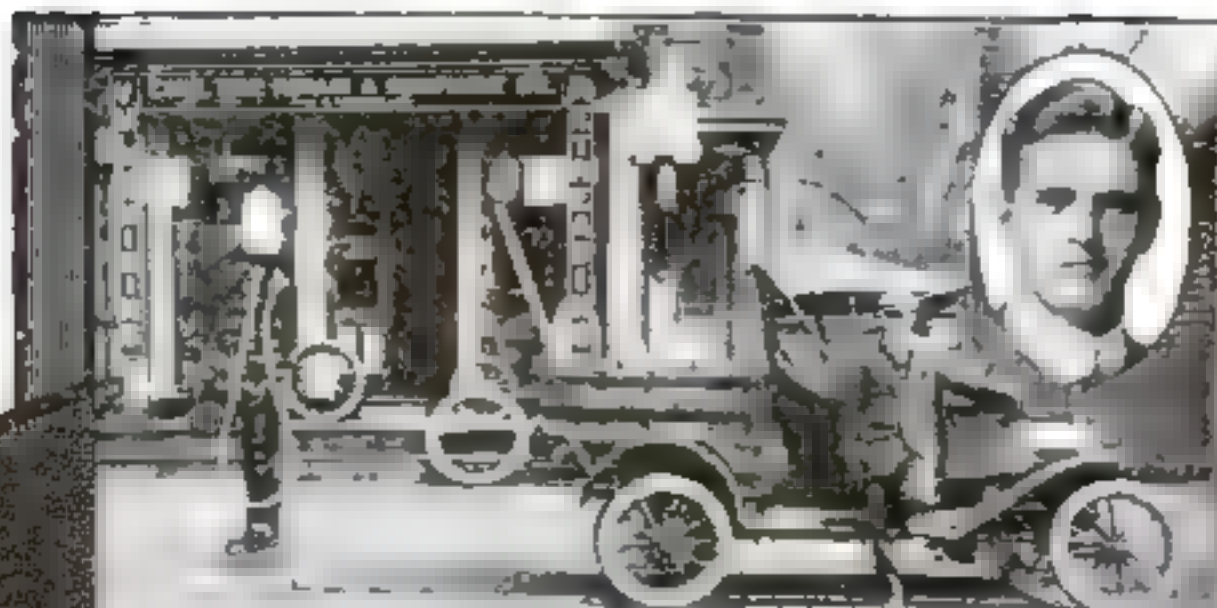
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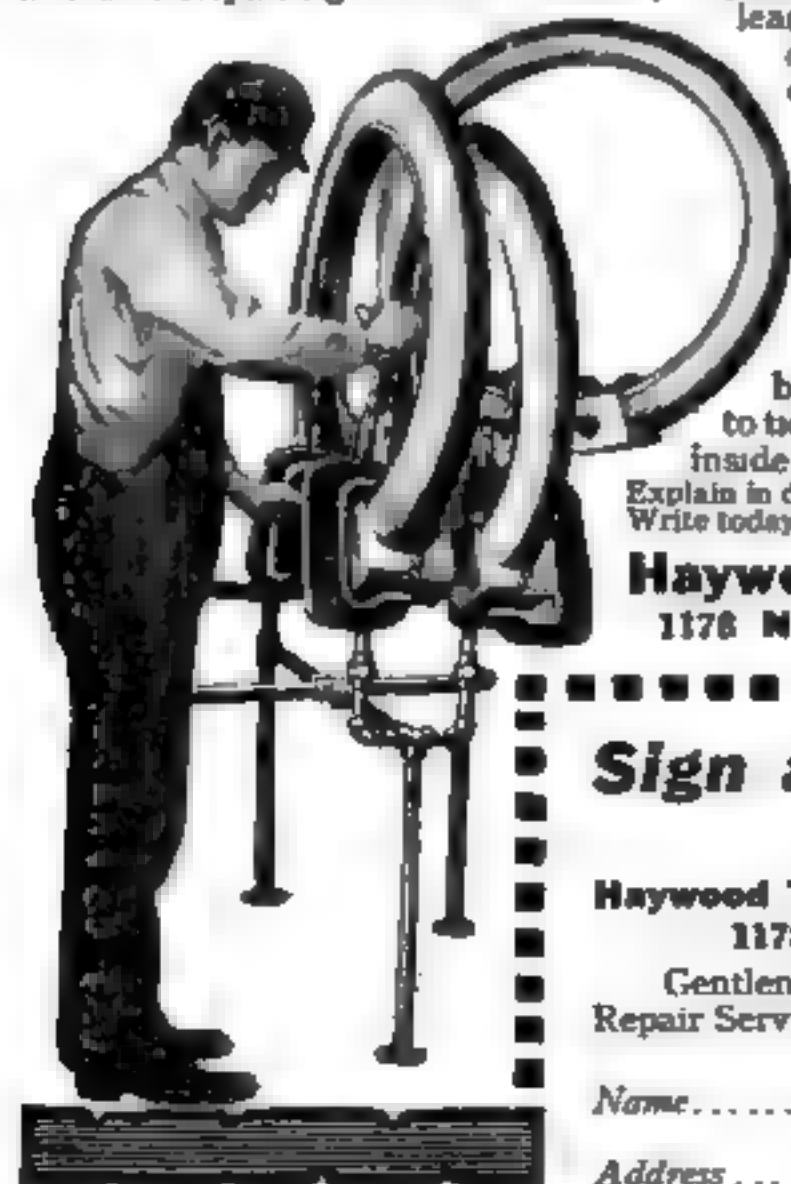
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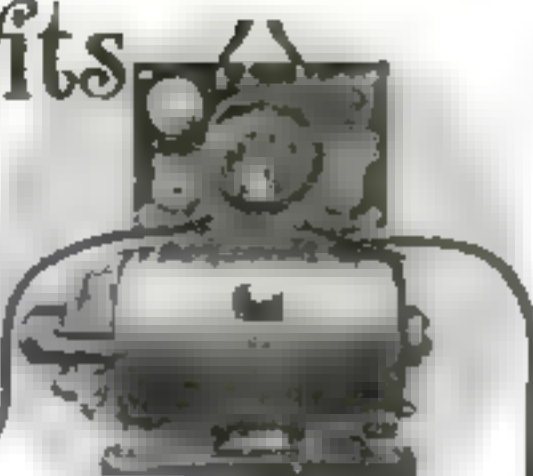
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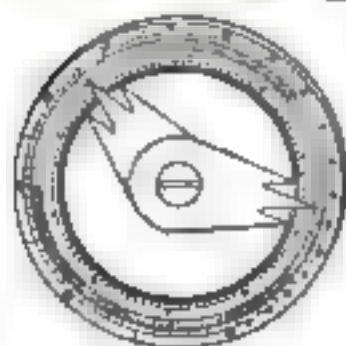


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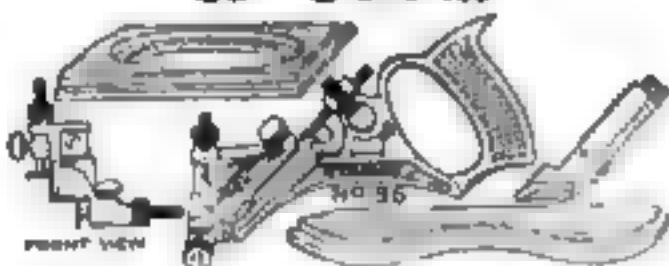
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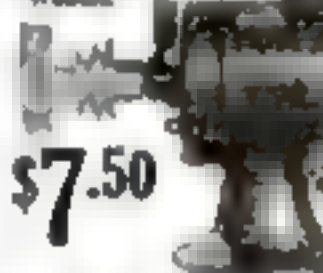
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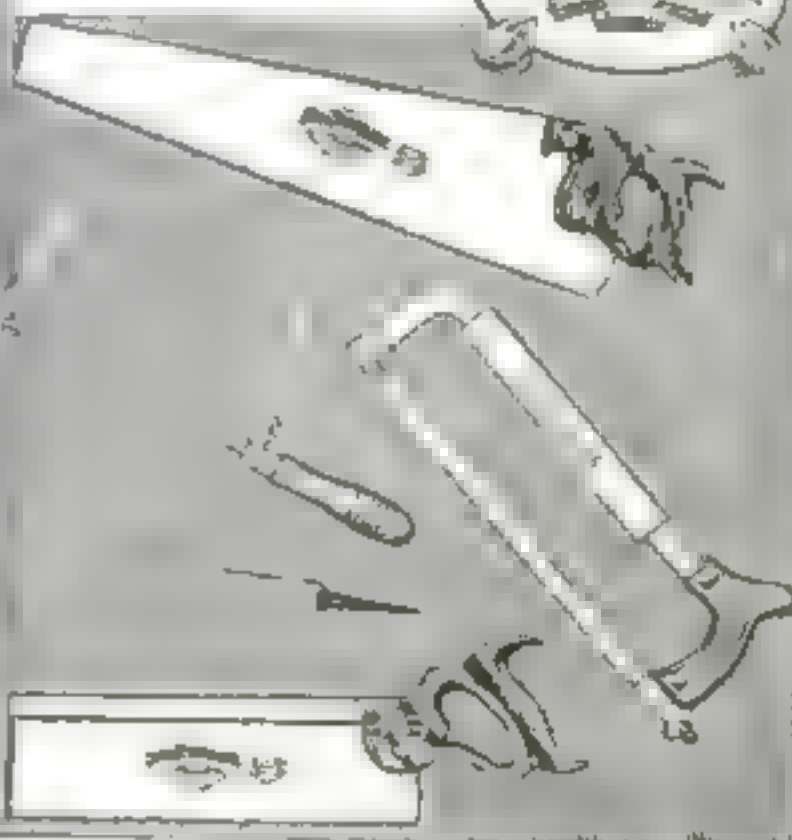
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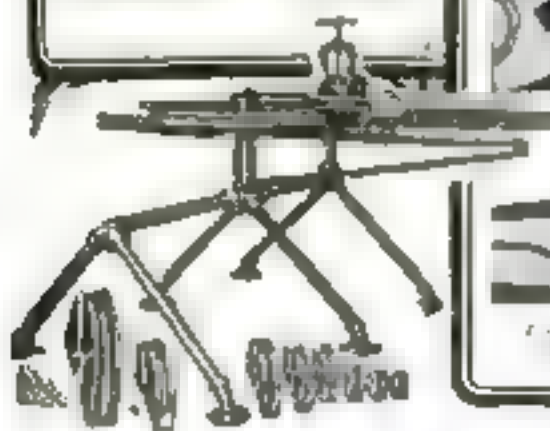
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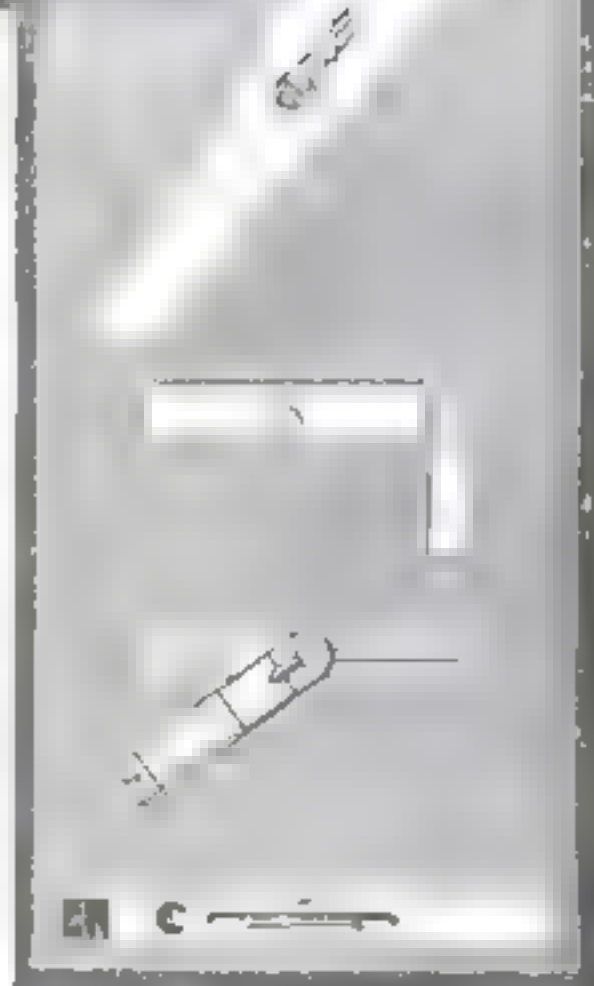
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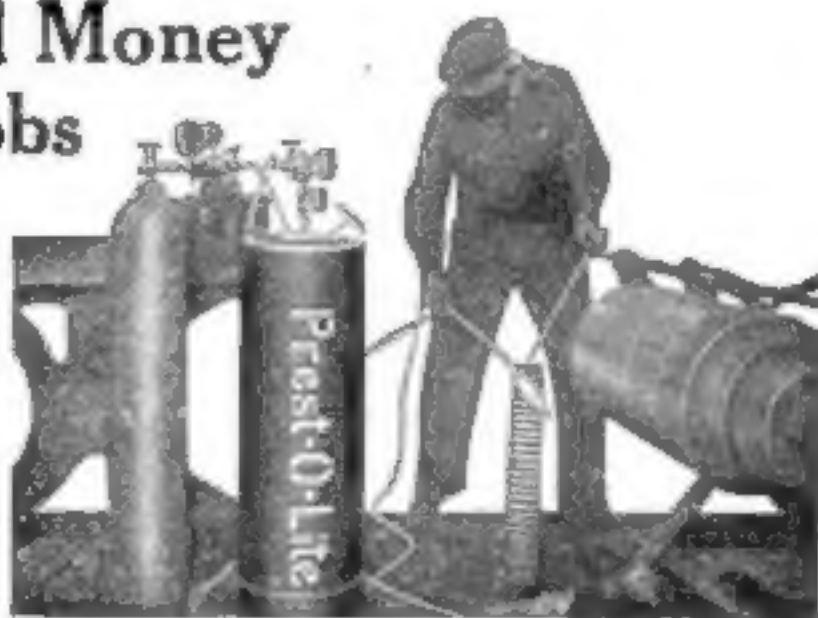
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